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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

DECEMBER 9.

Institution of Mechanical Engineers:—Informal meeting in London. "Economics in Engineering," by Major S. J. Thompson, D.S.O.

North-East Coast Institution of Engineers and Shipbuilders:—Informal meeting in the Institution Library. For discussion: "The Relation Between the Drawing Office and the Shipyard and Engine Works," by C. Waldie Cairns, M.Sc.

DECEMBER 10.

Swansea Technical College Metallurgical Society:—General meeting at Swansea. "Roll Designs and Rolling Mills," Paper by G. E. Butler.

DECEMBER 12.

Institution of Automobile Engineers:—Ordinary meeting at Birmingham. "Experiments on Various Gaseous Fuels in a High-speed Internal-combustion Engine," Paper by Dr. A. F. Burstall.

Institute of Metals (Scottish Local Section):—Ordinary meeting at Glasgow. Paper by Robert Kay, Ph.D., on "Age Hardening of Alloys."

DECEMBER 15.

Institute of Metals (Birmingham Local Section):—Lecture by L. Aitchison, D.Met., F.I.C., on "Duralumin." Joint programme arranged by the Birmingham Metallurgical Society and the Staffordshire Iron and Steel Institute.

DECEMBER 16.

Sheffield and District Branch:—Ordinary meeting. "Iron Foundry Practice," Paper by H. J. Young.

Middlesbrough Branch:—Ordinary meeting at Middlesbrough. "Machine Moulding," Paper by W. J. Molineux.

Towards Simplification.

Attention was recently drawn in these columns to the mass-production of Papers referring to the foundry industry. Papers presented to the various branches of the Institute of British Foundrymen in the course of a session may be roughly divided into two classes. In the first come those which deal with something really novel; that is, they expound a new idea in foundry practice, describe a new piece of foundry equipment, or make a new contribution to the metallurgy of the subject. The second group covers Papers which are just as important but not necessarily novel. They are broadly educational or semi-educational in character, and are sponsored by someone of adequate practical experience and knowledge for the express purpose of securing those advantages which can only accrue from personal discussion and interchange of ideas at a meeting. They may survey existing practice, expound well-known questions from the fresh angle of a new author, or describe common types of equipment. Furthermore, they may treat technical matters simply with a view to interesting juniors and others who may not have had occasion previously to study the subject.

Among the branches of the I.B.F. there is very considerable autonomy over the arrangement of winter programmes. Probably no national society gives its branches more freedom in this respect, and the cost is proportionately high. There is keen competition for the few people who really can lecture. The cost of preparing a lecture is considerable, both in time and money, especially, as a correspondent recently pointed out, if lantern slides are necessary. The advantage which impels the lecturer to speak to a technical society rather than sell his material to the technical Press is that of securing proper discussion and criticism. Does the present arrangement ensure this? Is the ordinary member sufficiently aware of distinctions between Papers that are or are not elementary, that are or are not novel? Can he always distinguish between a Paper for the Junior and a Paper for the Senior section? When in doubt he frequently finds the simplest solution in staying away, thus depriving the lecturer of the very stimulus he wants and the Institute of the interest of its members.

In the nature of things it is unlikely that the industry could provide more than six or eight really new foundry Papers per annum. We suggest that some of these, say half, might be reserved for the Convention, and the others read and discussed during one season by all the branches in turn. Where an area, such as Lancashire, contains more than one branch, joint meetings might be held on such special occasions. Such an arrangement would ensure to every member an opportunity to discuss every important new Paper. The Papers could be approved by the Literary Committee and commended to but not forced on the branches. These could be confined to Papers of strikingly novel *treatment*, and to those occasional masterly reviews or surveys of current practice which are chiefly valuable as sources of reference.

The Institute would thus exercise responsibility for what it put before members, ensuring for every branch several special features each session. The rest of the programme would consist of Papers of the second type, mainly contributed by branch members themselves, or of open discussions, to which a number of members could contribute.

A Sheet Anchor.

It has often struck us that the Christian religion has suffered in recent years through the almost universal scepticism of the existence of a material heaven and hell. It has lost its bed-rock anchorage. Medical research, too, seems to be dragging at its anchor. Surely its aim should be the gradual elimination of hospitals by the general increase in the health of the people. Instead of this they are apparently creating an enormous industry with vested interests analogous to steel or textiles. Now the cast-iron foundry industry, too, needs a good bed-rock anchorage, and the natural material upon which to base it is strangely enough cast iron. In recent times the tendency seems to be to base research work on pure iron-carbon alloys. This, of course, is essential in order to ensure a clear conception of the fundamental principles. Here, however, it stops, because we fear that every investigator has it in the back of his mind the creation of an improved material, somewhat akin to cast iron but really competitive with malleable cast iron or mild steel. So long as the material is "manufacturable" by ironfounders at a competitive price so much the better, but if it is really a job for the steel maker or the malleable cast iron founder, it is not unreasonable to ask these sections of the industry to pay for it. There is more in cast iron research that the provision of high duty iron, such questions as skin, soundness, the ability to use the cheapest of raw materials, are equally important if not quite so fascinating. The message we wish to emphasise, that so long as research workers will bear in mind that the industry has at the moment, and must continue to have, a sheet anchor, then it will progress, and just as soon as this anchorage becomes ineffective then progress will be impeded. We envisage in the near future that engineers will cease to mention cast iron as such, and rather will they refer to any one of the various names by which some of the recent developments are known.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Metallurgy of Gear Manufacture.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with great interest the account of the recent visit of the Lancashire and West Yorkshire Branches of the Institute of British Foundrymen to the works of Messrs. David Brown & Sons, Limited, Gearing Specialists, Huddersfield, and the subsequent excellent lecture on "Metallurgy in Gear Manufacture" delivered by Mr. F. W. Rowe, the above firm's chief metallurgist, as reported on pages 139 and 140 of your issue of November 24.

Mr. Rowe has given us some very interesting information on cast iron for machine-cut gears, and among other things he states that "the best wearing iron was that consisting of a eutectoid matrix—that was, where no free ferrite was present and the combined carbon was approximately 0.90 per cent. It was rarely possible, however, using ordinary founding methods, to have metal of this composition in the actual teeth of a gear which, as the portion in which the teeth are subsequently cut was usually the heaviest, and if the composition of the metal were such as to give a eutectoid base in this area a considerable amount of free iron carbide would be present in the lighter parts of the wheel, etc.," and, to quote further, Mr. Rowe goes on to state, after dealing with the necessity of maintaining a happy medium in regard to the total carbon content, that "the silicon content was also of importance . . . . . a low silicon content of 1.2 to 1.4 per cent. was *necessary* to secure the requisite hardness (hardness here evidently being synonymous with resistance to wear?), but for the general run of gear blanks this was too low and much more satisfactory results, as regarded soundness, would be obtained by using a silicon content of 1.6 to 1.8 per cent."

Perhaps Mr. Rowe will be interested to know that by the Lanz Perlit iron process it is possible in everyday foundry routine to produce light and medium-section gear blanks and similar castings with 0.7 to 0.9 per cent. silicon and 2.9 to 3.2 per cent. total carbon, in which the matrix is entirely eutectoid (free ferrite and free carbide of iron being absent) not only in the lighter sections, but also in all other sections or areas of the blank. The wearability of such gear blanks has been proved to be much superior to that of gear blanks made by any other process where the composition and consequently the structure of the heaviest sections is dependent on the absence of free carbide of iron in the lightest sections.

Mr. Rowe has also drawn attention to the very important point that "phosphorus affected the shock-resisting properties of cast iron, and for this reason was not allowed to rise above 0.9 per cent. in any class of gear work."

The obvious retort is, Why go so high as 0.9 per cent., when it is very easy to make excellent readily-machinable, all-pearlitic cast iron, containing really low percentages of silicon, with moderately low total carbon and with a phosphorus content of 0.25 per cent. or less?

Quite apart from the question of shock-resisting qualities, Otto Lehmann, in his classic research on "The Frictional Wear of Cast Irons" has recently shown us, amongst other things, that in most cases the presence of much free phosphide unfavourably affects resistance to wear, and that the greater the percentage of pearlite present in any given sample of cast iron, other things being equal, the greater the power of resistance to wear.

In conclusion, I wish to congratulate Mr. Rowe on his excellent and instructive lecture and wholeheartedly to endorse his supposition that the best wearing irons, and at the same time readily machinable, are those which possess an entirely eutectoid matrix. May I humbly suggest that the best way to attain this objective, especially in the case of gear blanks where the portion in which the teeth have to be cut is the heaviest, is by the adoption of cast irons moderately low in total carbon, low in phosphorus, and with silicon under 1.0 per cent? Also that with the further improvement of such irons by the addition of alloying metals, such as nickel and chromium, or both, I look to a very great future for high-duty cast irons, not only in the case of wear-resisting castings, but for a great and ever-increasing variety of uses too numerous to mention here.—Yours, etc.,

A. E. MCRAE SMITH,
Metallurgist.

Dartford. December 3, 1927.

Spanish Conditions.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—One of our esteemed associates has sent us a copy of your important publication of November 10 containing an article unfavourable to this country, inopportune moreover, as it appeared at a time at which preparations are being made to work out the details of the International Foundry Congress in this city (Barcelona).

Spain is not so far from England as the writer of "Random Shots" tries to make it. The connections between the French and Spanish trains are perfect, and the service on the inland railways leaves nothing to be desired. The public roads are in good state; in the larger cities there are magnificent hotels, and in Barcelona especially, the population of which amounts to one million inhabitants, situated three hours from the frontier, rival in beauty, comfort, culture, movement and entertainments with the best in Europe.

By the same post we are sending you some propaganda literature relating to this city to prove our contentions.

Requesting you not to allow the insertion of any more or less hostile matter to our country in your columns, I remain, yours, etc.,

MANCIO RUBIO,
the President of Society for the Attraction of Foreigners to Barcelona.

[We regret that we should have allowed our contributor, "Marksman," to suggest that railway connections are poor in Spain, and sincerely apologise for what we are convinced is a travesty of the truth.—EDITOR.]

Institute of British Foundrymen.

London Junior Section.

At a meeting, held in the offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, London, W.C.2, Mr. H. J. Young, F.I.C. (Consulting Metallurgist) gave a "talk" to the members of the London Junior Section, the title of his address being "Applied Science." Mr. P. Ellis (Chairman) presided.

The lecturer said his audience represented so many different trades that he thought he would touch lightly upon a number of subjects, dealing with each in simple language. The following were considered: How chemical analysis is done; what happens when molten metals are mixed; what occurs when metal is poured into moulds; the manner in which a piece of metal breaks; and why small amounts of impurities can have great effects.

Each section was discussed with the youths, who were particularly interested in the lecturer's description of the breaking of a piece of metal. Mr. Young emphasised how important was this matter, quoting several cases, in each of which the actual manner in which a particular piece of metal had broken was the deciding factor in an important dispute. He pointed out that when a piece of metal was stressed, fatigue generally took place through the crystal grain and not in between it as one would expect. The meaning of the term "fatigue" was explained at length, and different methods of testing metals were described.

The lecture aroused a long and keen discussion, after which a hearty vote of thanks was passed to Mr. Young.

The next meeting will be held on Friday, December 16, when Mr. V. C. Faulkner will speak on "Continental Foundries."

Random Shots.

I have been much pained—being, like most of us, unable for economic and other reasons to tear myself away from the charms of home—to note the attention given on all hands to the attractions and advantages of wintering abroad. It seems that this may take two forms, which share the features of heavy expenditure and lavish display of new clothes, both carefully calculated to appeal especially to the feminine section of the community. If you be young and energetic—and preferably slim in build—you can seek an active holiday and go in for weird and wonderful sports in Switzerland, while if you be old and lazy and on the heavy side, you can instead bask idly in the sun of the Riviera.

* * * *

Both, no doubt, are excellent things to do, but how unnecessary. There has been a tendency of late to extol the winter charms of other parts of the world—sports in Scandinavia and sun in Africa, for example. But why go so far afield? Can we not offer in this country climatic and sporting advantages that are unique? *We* are not limited to painful attempts to overcome the difficulties of mobility in mountainous regions, nor forced to pretend that we enjoy the limitations imposed on our movements by abnormal sunshine. No, we at least can be original.

* * * *

For instance, no real attempt has yet been made to popularise the admirable sport of swimming the Serpentine, which, although so eminently suited to our moist climate, has hitherto been limited to a small band of enthusiasts. Against the merits of sun-basking, moreover, can we not offer a rival attraction in the shape of fog-basking? Is there any other country in the world that could show its visitors the darkness of midnight in full daytime (unless it be situated in the Arctic Circle, in which case it would not, of course, really count, having an unfair advantage)? Or where else could one study so effectively the charms of fog in all its variations, white, grey, black, green, yellow, or London special? While although we cannot, it is true, boast the sugar-cake glories of a casino, there is sure to be some greyhound racing going on somewhere.

* * * *

No, what we English lack is a sense of publicity. Our cousins across the Atlantic would long ago have succeeded in attracting countless hordes of moneyed foreigners had they been blessed with the attractions of our unique winter; and even our Continental competitors could teach us something as to the kind of bait with which to attract the holiday-maker. How far the visitors attracted in this way would be satisfied with value received is a somewhat doubtful point; our climate *might* take it into its head to do something to pacify the grumblers with their cries that it never used to be like this. But how comforting it would be to that vast mass of us who have never been abroad in winter—except on business, which is worse than staying at home—to think that we were provided free, gratis, and for nothing with all the immeasurable advantages for which other people were paying so heavily. No doubt the native Swiss who is unable to spend the winter abroad finds considerable solace in similar reflections, what time he wonders that snow and ice should have such power to charm the stranger.

* * * *

Still, although the weather has done its best to monopolise our attention, and the advertisers of winter tours have not hesitated to suggest the remedy, there have been just a few other things going on. There have, for example, been floods in other parts of the world, just to show us that we have no exclusive rights; and another International Conference at Geneva; and a change in the world's chess champion; and several bye-elections deplorably lacking in excitement; and a rumour of some slight activity at Westminster; and business has gone on as usual. And, just to show that all interests are catered for, there have been several society weddings and a charity ball or two.

MARKSMAN.

The Works of Stewarts & Lloyds, Limited, Clydesdale Iron and Steel Works.

These Works are situated at Mossend and are served by the London, Midland and Scottish Railway Company. They have recently been remodelled and modernised to enable them to manufacture rolled-edge plates in an up-to-date universal mill. The Works comprise melting shop, cogging mill and universal plate mill, with the necessary gas producers, re-heating furnaces, shearing plant, and other auxiliaries.

Melting Shop.—This contains eleven 50-ton open-hearth furnaces, two of which are acid-lined, and the remainder basic-lined. They are served by three open-hearth charging machines of the overhead type. The casting ladles are handled by two 100-ton overhead cranes. The ingots are cast on cars and transferred by locomotive to the stripping bay. The raw materials for the melting shop are assembled in a stock-yard parallel to the melting shop, which is served by three gantry cranes provided with lifting magnets, which transfer the scrap and pig-iron to the charging boxes, which are then run by a locomotive into the melting shop. The gas for the melting and ingot re-heating furnaces is generated in thirteen Morgan gas machines, which replaced forty-five hand-operated producers. These gas machines are equipped with automatic regulators, which keep the gas pressure constant, and so make for economy and efficiency at the furnaces. The fuel for these gas machines is received in a central pit and is taken from there to the hoppers over the producers by an overhead crane provided with a grab bucket. The hoppers have a sufficient capacity to keep the producers working for twenty-four hours. The ashes are loaded direct into wagons on a narrow gauge railway on which they are taken direct to the ash tip.

Ingot-Stripping Shed.—After the ingots have set sufficiently, they are removed on their cars to the stripping shed, where, by means of an overhead crane, the moulds are removed and set on empty cars on a parallel line of rails. The cars with the stripped ingots are then run forward to the cogging-mill department.

Cogging-Mill Department.—In this department there are three ingot re-heating furnaces of the gas-fired regenerative type, having hydraulically-operated rolling covers. The ingots are charged and drawn by an overhead charging machine of the rigid-arm type. When the ingots are at a rolling temperature, they are withdrawn from the furnace and deposited in a tilting ingot chair, mounted on a travelling carriage drawn by a wire rope, which takes it to the cogging mill and deposits it on the entering rack. The tilting of the ingot is performed by an electric motor mounted on the carriage. The slab-cogging mill is the old mill widened to take the ingots required for the universal mill and is of the two-high reversing type, having rolls 40 in. diameter. It is provided with live-roller racks and screw-gear electrically-operated and with hydraulically-operated tilters. The mill is driven by a pair of horizontal non-condensing reversing engines of the usual type. The ingot, after cogging, is cut to the required lengths in a vertical steam-driven slab-shearing machine, having live rollers on the entering, and a floating chain table on the outgoing side. After shearing, the slabs are either taken direct to the universal mill or stored in the stock bay, which, before remodelling, contained one of the old plate mills.

Universal Mill.—This fine mill with its auxiliary plant is housed in a spacious building 960 ft. long by 107-ft. span, with a side building 570 ft. long by 50-ft. span. The slab re-heating furnaces, five in number, are of the gas-fired regenerative type. They are served by two overhead slab-charging machines of the side-grip type. The gas for these furnaces is generated in three Morgan gas machines. After the slabs have been brought to a rolling temperature, they are withdrawn from the furnaces and placed on a travelling carriage, which conveys them alongside the entering rack of the universal mill. By means of a screw-thread on the drum shaft working in one of the bearings formed into a nut, the drum is moved on end so that the rope always leads straight on to the drum. Arrived alongside the mill rack, the slab is pushed off by an electrically-operated pusher, which travels forward horizontally, but on the return stroke rises to clear the top of the carriage, which can then immediately return to the re-heating bay. The universal mill, which embodies all the latest American improvements, has horizontal rolls 34 in. diameter and four vertical rolls, two on each side of the mill, each 26⅜ in. diameter on the barrel. The main housings, which are of steel, are placed at 18-ft. 11½-in. centres. The vertical rolls are capable of being spaced at any distance between their barrels from a maximum of 4 ft. 1⅜ in. to a minimum of 7⅜ in. The mill is driven by double-helical pinions 58 in. wide on the face. The pinion, which is connected to the top roll of the mill, is driven from an electric motor. Above the driving pinion is an idle one into which two pinions gear to drive the vertical rolls through bevel wheels. The pinion housing is a massive steel casting, having the bearings provided with gravity lubrication, whilst a spray of oil is arranged to play on the teeth of the pinions. Electrically-driven live-roller racks are provided on each side of the mill. All the housing screws, both for the horizontal and vertical rolls, are electrically-operated. Dials of the clock-face type are provided for all the rolls, on which the long finger makes one complete revolution for one-inch movement of the rolls, whilst the short finger indicates the number of whole inches which the rolls are apart. The dial for the horizontal rolls is divided into 100 parts, so that the rolls can be set to 0.01 in. The mill is operated from a control platform on which are mounted all handles for operating the main mill motor and all auxiliaries.

Cooling Bed.—The delivery rack from the mill is continuous with the entering rack of a plate-flattening machine, or mangle, which is of the nine-roller type, electrically-operated. The delivery rack from the mangle in turn is in line and continuous with a rack, which extends the full length of the cooling floor. On the other side of the floor there is a similar rack to receive the cooled plates. The plates are traversed across the cooling floor on heavy plate-link chains running in grooves in cast-steel lifting beams, which, when not in use, lie below the level of the rollers and stationary rest bars forming the floor. By raising the beams the chains can be brought into contact with the plates, lifting them clear of the live rollers and rest bars when, by setting the chains in motion, the plates can be moved across without risk of being scratched. To deal with plates which may not be quite straight on the edge there are 22 straightening blocks provided, divided into two groups of 11 each. These blocks are moved by screws and press, the plate being operated on against fixed straight-edges of length sufficient to deal with the longest plates.

Shearing Plant.—In line with the rack on the mill side of the cooling floor there is a rack leading to the guillotine shears, which are capable of shearing plates up to 66 in. wide and 1 in. thick. They are electrically-driven, and are used to trim the ends and cut to lengths the plates which are intended for use in the firm's tube works. After being cut to length, the plates are fed through pinch rolls on to a piling table, where they are made up into piles, which are then lifted away by an overhead crane. Heavier universal plates and sheared plates are transferred on the rack situated on the side of the cooling floor, remote from the mill, to a set of rotary shears, which can cut cold steel, of a tensile strength of from 26 to 32 tons per sq. in., up to a maximum width of 96 in. and a thickness of ¾ in. The blades are of special tool-steel ground hollow. Heavier plates up to 1¼ in. in thickness are transferred on a rack to a set of shears similar to the guillotine shears, already described, except that they can cut up to 96 in. wide. After shearing, the plates are transferred by cranes to the loading bay, either to be loaded on trucks or stacked to await shipping instructions.

Before leaving the mill it may be interesting to refer to very simple but effective devices which the Company have adopted to enable the men at the mill, mangle and shears to know what is coming forward. Opposite to the control platform from which the mill is operated there is placed a series of tables, divided into squares, which can be illuminated—not unlike the train indicators on the London Tube Railways. Each re-heating furnace is given a reference letter, and the position of the slab in the hearth of the furnace is indicated by a number. When a slab is drawn the heater lights up the furnace letter and number, indicating where in the furnace the slab was (for example, M3); the roller then knows from the stock sheet what it is to be rolled to. He in turn lights up numbers at the mangle and shears to let the men know the thickness of the piece coming forward, so that they may be prepared to deal with it.

Electrical Equipment.—As already stated, the mill is electrically-operated. This is effected by means of a reversing motor supplied with D.C. current from a flywheel equaliser set. The current is taken from The Clyde Valley Electrical Power Company and led to the E.H.T. switchboard, on which are the necessary switches, voltmeters, ammeters, and power-factor meters. The current to operate the motor of the equaliser set is stepped down, in static transformers, to 3,300 volts, at which pressure the motor operates. The equaliser set is driven by a three-phase motor rated at 3,000-h.p., but capable of taking overloads of 100 per cent. It is direct-connected to four 400-volt direct-current variable-voltage generators, which operate in series, and deliver current to the main mill motor. The V.V. generators are arranged two on each side of a flywheel, 12 ft. diameter, which, when running at the synchronous speed of 500 r.p.m., has a storage energy of 120,000 h.p.-seconds. The main mill motor is of the two-armature two-field pattern, and has a normal continuous rating of 4,500 h.p. at 80 r.p.m. in either direction, and is capable of taking peak loads of 25,000 h.p. and of giving a maximum torque of 590 foot-tons. By weakening the field it can be speeded in four seconds to 135 r.p.m. The exciter set is operated by a three-phase motor of 250 h.p. It is of the squirrel-cage type, operates at 440 volts, and has a synchronous speed of 750 r.p.m. There are three D.C. generators direct-connected to the A.C. motor, one to excite the V.V. generators, one to excite the main mill motor, and one for speed regulation. To enable the equaliser set to drop in speed, and so to allow the stored energy in the flywheel to be available, a slip regulator is provided under the control of a torque motor which, when a predetermined load is reached, puts resistance into the rotor circuit of the main A.C. motor, so causing it to slow down. The main mill motor is cooled by means of filtered air supplied by a fan capable of delivering 30,000 cub. ft. of free air against a head of 4-in. water-gauge. The oiling system consists of two centrifugal pumps, which draw their supply from a low-level tank and deliver it through a cooler to an overhead tank.

For the general supply of current to the auxiliary motors and for lighting there is installed in the power-house a mixed-pressure turbine geared to a direct-current generator of 1,500 kw. The exhaust steam from the cogging-mill and slab-shears engines is led to a Rateau head accumulator adjacent to the power-house. The condensing water is cooled in a natural-draft chimney-type cooling tower.

A Denial.

There is no truth in the report that the Stafford Coal & Iron Company, Limited, of Stoke-on-Trent, propose to close down their blast furnaces in the near future. The output from the furnaces is moving away satisfactorily, while many fresh contracts are being entered into, so that the New Year holds out prospects of increased rather than decreased production.

North-East Coast Founders Discuss Steel Problems.*

Mr. Stobie, who opened the discussion, said that Mr. Kirby had mentioned contraction pulls as being the bugbear of the steel foundryman, and he would like to ask what experience Mr. Kirby had had with pulls when using steel produced by the Tropenas method. His own experience with this method had not been very great. If the steel were particularly hot in order to make a thin casting, it would very readily oxidise, which in its turn would cause pulls. Electric steel, cast at the same temperature as Tropenas steel, is less fluid than the latter, due to comparative freedom from combined oxygen. In one case of a cast of electric steel, Mr. Stobie said that the foreman thought that the quantity he needed was 4 tons, but he discovered that he would require another ½ ton when they were busy casting the job. Therefore they took some steel, which was being melted in another electric furnace, to make up the weight. The new steel was not finished and was in a well oxidised condition. Ferro-silicon was put in the ladle to kill it. It would be at least 50 deg. lower in temperature than ordinary electric steel casting temperature, but it ran all right through its not being properly killed. In another works, where the Tropenas method only had been used, complaints had been that in making electric motor frames there were considerable numbers pulled. Electric steel, which is more thoroughly deoxidised, was later adopted and, immediately, the pulls were much fewer. He had been rather interested in Mr. Kirby's remarks on chills and the different thicknesses of different parts of castings. The thickness, given by Mr. Kirby, of 2 mm. for the steel frame exhibited was the least Mr. Stobie had heard of.

Cores Embedded in Large Masses.

Mr. Paulin, referring to a segment of a casting which Mr. Kirby had shown, asked if he was right in supposing that an oil-sand core had been used for it. They had had several illustrations in previous lectures of cases where thin cores were surrounded by large masses of metal, and where the cores had been so affected by burning as to have not sufficient stability, with the result that the metal burned into them. Mr. Paulin also questioned Mr. Kirby as to whether he took any special precautions with oil-sand cores and whether he treated the skin of the core in any way. Another point which he mentioned was that of contraction. He had seen a wheel cast in halves which when examined had shown that the rim had contracted inwards owing to shrinkage. In the case of a bottom end bearing of a connecting rod, however, it had contracted outwards. Could Mr. Kirby give any particular reason why contraction should act differently in those cases?

Mr. Watson asked why six separate heads were used on blank wheels instead of adopting the German method of having a continuous head right round the rim. He also mentioned having noticed the difference in the contraction of two steel castings which were both made from the same pattern.

Sand Control.

Mr. C. Gresty said that most of those present that evening were engaged in ironfounding rather than steel founding and they would realise from the Paper that the difficulties of the latter were even greater than those of the former. Mr. Kirby had mentioned the expense connected with the removing of extra heads, risers, and so on. What did he consider was the best way to remove them—by sawing, or by burning with oxy-acetylene, or was there any other means. Mr. Kirby had laid great stress on the necessity of venting and he (Mr. Gresty) was of opinion that in ironfoundry work also venting was of the greatest importance. In his Paper Mr. Kirby had also said that he preferred internal chills which are really fused into the metal. Did he recommend that these spikes, etc., should be tinned, or was there any other treatment equally satisfactory? Several references were made in the Paper as to the necessity of correct moisture of the sand, and he (Mr. Gresty) would like to know whether Mr. Kirby made any actual moisture determinations, say, at regular intervals, or what means he used to ascertain when the sand was correct in this respect.

Mr. Brailsford, after congratulating Mr. Kirby, said he was not entirely in agreement with Mr. Kirby that oil sand cores were more expensive, for the intricate castings made to-day they were cheaper, and made it possible to make difficult castings. He had in mind a case where the engineers were giving the foundries four sets of certain cores to be made per day by a coremaker; as this was far too few, they tried using oil sand cores, and were then able to turn out 14 sets per day. His experience in making turbine pumps was that instead of building the centre core with bricks as in most foundries, he had a half-round frame made and swept one half at a time. He then bolted them together, using fish-plates at each side. He found the core strong enough to stand bolting together without core irons. This method proved a great saving in time, up to about 50 per cent. He insisted that it was not entirely new to sweep wheels in halves simultaneously. Of course one has to move the box over on the moulding machine, where the centre cannot be altered, but in making the same wheel without a machine one would have to move the spindle over 2 in. to the other side after sweeping one side. When finished it would have to have a splitting core down the centre.

Mr. Frier asked Mr. Kirby what the casting temperature of steel was. Mr. Kirby had said that he had found that castings made in moulds treated with paint were generally more faulty than those made with ordinary mixed sand. Could he tell them what the mixings of sand were for those moulds? Another point was what sort of material they used for compo. and the proportions used. Mr. Kirby had also referred to the size of the runners and down gates. He took it that that had meant that if the down gate was 1½ in. it was not advisable for the ingate to be 2 in. It would be better to have a row of small ones which would give the same area as the down gate or did he mean that there could be as many ingates as one liked so long as none of them were larger than the down gate. With regard to sand being mixed with sawdust, he had heard of castings being made in oil sand blocks with no casting box round them, and being cast the same as in the brass foundry, that was one on top of the other.

Mr. Molyneux said that he supposed that when Mr. Kirby referred to pouring a steel casting so that the bush was kept full he meant pouring over the lip of the ladle and not from a bottom pouring ladle. Referring to the brackets they had seen, what thickness would they be? Oil sand cores were, generally speaking, cheap, taking the overall cost, that was the cost of labour and added cost of the oil sand. With what did Mr. Kirby coat these cores so as to fill in the grain on the surface of the core?

Mr. Stobie asked Mr. Kirby his view of the relative sizes of the headers. He had noticed that where there were small heads the ingates were extremely small also. Had Mr. Kirby found some advantage from tall heads other than the slight increase of pressure attained?

Another Reply.

In reply to the various remarks, Mr. Kirby said that he would answer Mr. Stobie's question concerning the area of the heads first. Better results were obtained from large heads because the steel was bound to remain molten longer in a larger area, and to be constantly drawing upon the hot steel. He could give no explanations of methods other than the Tropenas. In answer to Mr. Stobie's other question, he said that it would be practically impossible to cast mild-magnet castings without "dummies" being placed in the holes. Referring to Mr. Paulin's question about contraction, Mr. Kirby said that distortion was caused in many cases by the casting not being eased sufficiently quickly. Incorrect pouring temperature also caused distortion. In the case of a casting contracting inwardly as had been mentioned, possibly the reason was that it had been eased too quickly. With a crank casting distortion would probably take place in the annealing stove or ducts, the top part of the mould perhaps being lifted off before the casting was properly set. The reason why they did not adopt the German method as Mr. Watson had suggested, instead of having six heads on the blank wheels, was largely a matter of cost. Mr. Gresty had asked which way he (Mr. Kirby) recommended for removing the heads and risers. He preferred sawing them off, but the time could not be spared to do this and they were forced to burn them off, which should be done before annealing. Referring to the question of internal chills, they were specially tinned, some foundrymen using ordinary wrought iron for the spikes, and others coating with red lead, but these were liable to rust. He took no tests to ascertain the moisture of the sand, but could tell by the feel of it. It was satisfactory so long as it would hold together and yet not stick to one's hand.

Mr. Kirby said that he quite agreed that oil sand cores were cheaper in some cases, he had just referred to the cost of the sand itself. The sweeping up of a wheel in halves had been mentioned; it was quite impossible to make machine-moulded wheels in halves without using that method. Mr. Frier had asked about the temperature of steel; the temperature certainly varied. It would be somewhere about 1,500 deg. C. at the time of casting. He had obtained better castings without painting. The paint acted as a blanket to the mould and stopped gases escaping: in other words, it blocked the mould reducing the permeability. As regards the mixing of the compo, English-manufactured sand was used and weakened with pure silica sand, as required. In no case ought the ingate's total area to be as large as the down gate, because the runner bush would not be kept filled up when pouring. In reply to Mr. Molyneux, Mr. Kirby said that they poured over the lip of the ladle.

On the suggestion of Mr. Stobie, Mr. Gresty proposed a vote of thanks to Mr. Kirby, which was seconded by Mr. Paulin and passed unanimously.

* Being a discussion on Mr. Kirby's Paper on Steel Foundry Practice published in our issue of November 27.

German Foundry Paper to Extend Scope.

On January 1, "Die Giesserei" ("The Foundry") is to become not only the official organ for the German Ironfoundry Employers' Federation (Verein Deutscher Eisengiessereien Giesserei Verband), but also the German Foundrymen's Technical Association (Verein Deutscher Giessereifachleute). From that date the paper will be published not by Oldenburg Company, of Munich, but by Stahleisen, of Düsseldorf, or more accurately, Giesserei Verlag G.m.b.H., a company just formed for that purpose. The Verein Deutscher Eisenhüttenleute, which is also interested in this new concern, will no longer publish articles of purely foundry interest in "Stahl und Eisen," so that "Giesserei" will be the sole representative German technical journal for foundry matters.

The Fourth Annual Refractories Ball.

The fourth annual Refractories Ball will again take the form of a dinner dance, and will be held on Friday, January 6, 1928, at the Grand Hotel, Sheffield. Application for tickets (15s. each), accompanied by the appropriate remittance, should be addressed to Mr. Arthur Whiteley, Hon. Assistant Secretary, Wicker Arches, Sheffield.

A New Electric Furnace.

On Tuesday last a large number of Press representatives were the guests of Messrs. Edgar Allen & Company, Limited, of Sheffield, to witness a demonstration of an Ajax-Northrup electric furnace of 4-cwt. capacity, the technical details of which have already been printed in these columns in the form of a Paper written by Mr. D. F. Campbell, M.A. It is used mainly for making tool steel, but the foundry does from time to time take special metal from it for casting impellors.

The Volumetric Estimation of Zinc in Aluminium Alloys.

By H. H. Shepherd.

When the percentage of zinc in any of these alloys exceeds 2.0 per cent. the determination of the amount should be carried out by the volumetric method, or, to be more precise, the potassium ferro-cyanide method. Higher percentages than 2.0 per cent. are difficult to estimate by the gravimetric or phosphate method. Even when this latter method is used and great care is taken, the results are invariably inaccurate when working on high-zinc alloys. Below 2.0 per cent., however, the gravimetric process is very applicable, and will give, in many cases, more accurate results than the volumetric method, especially where the quantity is very small.

Solutions Required.

The following reagents are required:—Sodium hydroxide solution (25 per cent. in water), sodium sulphide solution (both 15 per cent. and 1.5 per cent. sodium sulphide), a 0.20 per cent. solution of uranium acetate in wafer, and two standard solutions, one being a standard solution of potassium ferro-cyanide and the other a standard solution of pure zinc.

The sodium sulphide should be made from only the pure salt, which should be perfectly white in colour, and should be kept in a well-stoppered bottle, preferably of dark glass, and the salt crystals also, otherwise the salt and the solution rapidly deteriorates. The 1.5 per cent. solution can, of course, be made from the stronger solution. To prepare the uranium acetate dissolve 0.20 gramme of the salt in 100 c.c. of warm distilled water, filter if necessary; this solution is used as the indicator for the titration.

Standard solution of potassium ferro-cyanide.—A suitable strength is one possessing a zinc equivalent of approximately 0.01 gramme per c.c. It is prepared as follows:—Grind in a clean Wedgwood mortar a quantity of pure potassium ferro-cyanide to a fine powder. The crystals of the salt used should be of a clear yellow colour and free from any dark patches or other discolorations, as dark brownish patches indicate the presence of the "ic" salt. Weigh out exactly 21.60 grammes of the powdered salt, transfer it to a 250 c.c. tall form beaker, add about 70 c.c. of water, and warm the solution until the salt has all dissolved. If it is then not crystal clear filter through a small Whatman No. 40 filter paper, allowing the filtrate to run into a 500 c.c. calibrated flask. When the solution has filtered through, wash the paper and beaker well with cold water, finally dilute the solution to the mark. Before standardising the solution it should be allowed to stand for two or three days. The standardisation is carried out by the aid of the standard zinc solution.

Standard zinc solution.—The zinc used must be "pure electrolytic," which may be taken as containing practically 100 per cent. zinc. Weigh out exactly 5 grammes of the zinc, which should be in thin turnings. Transfer to a 250 c.c. tall form beaker. Add 50 per cent. dilute HCl, a little at a time until the reaction ceases, about 30 c.c. of acid should be used. Heat until the whole of the zinc has passed into solution, then dilute to about 100 c.c. with cold water, and make alkaline with ammonia, then just acid with HCl: add one c.c. in excess, cool if necessary, and transfer to a 500 c.c. flask and dilute to the mark, as in the case of the ferro-cyanide. One c.c. of this solution contains 0.01 gramme of zinc.

Standardisation of the potassium ferro-cyanide.—Fill one 50 c.c. burette with the standard zinc solution, and one with the standard potassium ferro-cyanide, both having previously been washed out with a little of the respective solutions. Allow 25 c.c. of the zinc solution to run into a 600-800 c.c. beaker, dilute to about 150 c.c. volume with water, and insert a thermometer, heat the solution to 80 deg. C. Whilst the solution is heating prepare a drop test plate and space single drops of uranium acetate on it. When the solution has reached the required temperature place it beneath the ferro-cyanide burette, and rapidly run in about 20 c.c. of this solution, shaking the solution in the beaker between the additions, or while making the additions. Continue the titration by adding 0.50 c.c. quantities; after each addition transfer a drop of the solution to the test plate, and allow it to fall on to one of the uranium acetate drops; when a brick red colour is formed on the mixing of the two drops read off the number of c.c. of ferro-cyanide used. Take another 20 c.c. of the zinc solution and repeat the titration, but taking care to be more accurate in obtaining the end point; that is, the burette reading should be accurate to 0.10 c.c. After reaching the last c.c. of the number of c.c. the first titration, finish off by adding only one or two drops of the ferro-cyanide at a time, and making a test for the end point after each addition. The titration is finished when the mixing of the drop of the solution with that of the uranium acetate just produces a brick red tinge. This colour reaction may be a few seconds before it appears, but the colour is very definite, and with experience one can with comparative ease secure an end point accurate to 0.10 c.c. As a guide to the approaching end of the reaction, it will be noted that the solution containing the zinc will become paler in colour when approaching the end point, and after experience it is possible to detect a change in the colour to an almost white coloration when the reaction is finished. The zinc equivalent per c.c. of the potassium ferro-cyanide is obtained by dividing 0.25 gramme (*i.e.*, the amount of zinc contained in the 25 c.c. taken for the titration) by the number of c.c. of ferro-cyanide required.

The Determination.

Weigh out 2.0 grammes of the alloy, place the sample in a 150-200 c.c.s. tall-form beaker, provided with a cover glass; add 40 c.c.s. of 25 per cent. NaOH solution; care is necessary at this point, the solution must not be warmed as violent reaction takes place, and there is a liability of the solution bubbling over the top of the beaker. The sodium hydroxide should be cold when it is added to the beaker containing the sample, the beaker should be placed in a shallow dish containing water as a safeguard against the reaction becoming too violent through heating brought about by the reaction. The reaction will probably not take place for some seconds; it commences suddenly and is very violent, heating the solution to near boiling point, hence the advisability of cooling. When the main effervescence has subsided, dilute the solution to about 70 c.c.s. with hot water; greater dilution should be avoided, as it tends to cause precipitation of the iron, or at least some of it in a finely divided form which often passes through the filter paper and is apt to cause trouble at a later stage. With high iron contents this trouble of precipitated iron hydrate often cannot be avoided.

Heat the solution to boiling and boil for three minutes, then remove the beaker from the source of heat and allow the residue to settle. The residue will consist of Cu, Fe, Sn, and Pb (that is of course if these are present), and some zinc; when dealing with L5 alloys the zinc left in the residue may amount to 0.60 per cent. or more. In the case of pure AL-Cu or Al-Cu-Sn alloys such as 3L11 or L8, made from the virgin metals or scrap from a virgin metal mixture. Much time and trouble can often be saved by testing the filtrate from the residue only for zinc, by the addition of sodium sulphide as given in the text later for the precipitation of the zinc in the sample. If the solution is clear after the sulphide has been added and it has been allowed to stand for about half an hour, then no zinc is present in the alloy. By this means of testing, unnecessary treatment of the residue is avoided. Further, if only a few tenths of a per cent. of zinc are detected, for ordinary purposes treatment of the residue can be omitted, provided that the washing of the filter paper after filtering off the residue has been done thoroughly.

To obtain strictly accurate results for the zinc content when this element is suspected to be present in any amounts over 0.50 per cent., it is necessary to treat the residue to extract from it any zinc it may contain. To do this proceed as follows:—

After the residue has settled, filter the solution through a 12.5 c.m. Whatman No. 1 filter paper, allowing the filtrate to run into a 400 c.c.s. beaker. The solution should not be very hot when filtering or the filter paper will break, due to the pulping action of the caustic solution; precaution is also necessary as regards the type of paper used, a thin quantitative paper is useless, it requires a coarse strong qualitative one, and it will be also found best to use the ribbed folded paper. Wash the filter and residue three or four times with hot water, keeping the volume of the solution as low as possible, under 150 c.c.s., remove the beaker from beneath the funnel and replace it by a 250 c.c.s. squat form one. The beaker containing the zinc is covered and put aside for a time, the residue and filter are treated with hot HNO_3. Allow about 20 c.c.s. of hot 2-1 HNO_3 to run on to the residue from a fine-bore pipette (this enables one to wash the paper thoroughly) and treat the residue without using an undue amount of acid. Treat the paper with another 5 c.c.s. of acid and then wash twice with hot water. To the solution of the residue obtained add 10 c.c.s. of 33 per cent. H_2SO_4 and evaporate to fuming, allow the liquid to cool and dilute carefully to about 25 c.c.s. volume. Neutralise with 25 per cent. NaOH, and add about 5 c.c.s. in excess, then boil for five minutes. Filter through a No. 1 12.5 c.m. paper, allowing the filtrate to run into the solution containing the main part of the zinc (that is the filtrate from the decomposition of the sample by sodium hydroxide). Wash out the beaker with the aid of hot water and a "bobby," also wash the filter and precipitate two or three times, after which the filter paper and contents can be thrown away. The solution now contains the whole of the zinc present in the sample taken, and should measure about 250-300 c.c.s. in volume.

Heat the solution to 70 deg. C. and add 45 c.c.s. of the 15 per cent. sodium sulphide, stirring meanwhile, again heat the solution to *near* boiling, remove from the heat, stir it well and then allow the precipitate of zinc sulphide to settle; the solution should be allowed to stand at least 45 minutes before filtering to ensure complete precipitation of the zinc.

Decant off as much of the liquid as possible through a No. 5, 15 c.m. filter paper; here again a ribbed folded paper will be found the most suitable. As the zinc sulphide is so fine and yet bulky, decanting is the best way of filtering the liquid rapidly; if the precipitate is much disturbed before the greater portion of the solution has been passed through the paper, then filtering will become very slow. After decanting off the clear liquid from the precipitate, transfer the latter to the filter paper, using a jet of warm 0.5 per cent. sodium sulphide to do this, and for washing of the filter and contents. *Water must on no account be used as it tends to dissolve the sulphide*, which is partially precipitated again in the filtrate, and consequently causes low results. The beaker is cleaned carefully and the washings poured on to the filter, the latter and the precipitate are then washed three times with the 1.5 per cent. Na_2S solution, each washing being allowed to run through the filter paper before adding another. When the last washing has run through, remove the beaker containing the filtrate; the latter should be crystal clear, if it shows a dirty milkiness then some of the zinc has found its way into the filtrate, and it must be refiltered; if this is necessary filter the filtrate through a fresh paper, the filtrate in both cases can be thrown away; place beneath the funnel containing the filter with the zinc sulphide a 400 c.c.s. tall form beaker. Cover the top of the filter with a cover glass, then

dissolve the sulphide by 50 per cent. HCl, using it in the form of a jet from a wash bottle; the cover glass is just lifted to deliver the acid, at the same time it is easy to prevent loss of the resulting solution by spraying. When the reaction has ceased, wash the cover glass and the filter paper well with the HCl, and then twice with water. Throw away the paper and place the beaker containing the solution on the hot plate, bring it to boiling point and allow the solution to boil until all the H_2S gas has been driven off, this usually means boiling down the liquid to about half volume. Now add about 2 c.c.s. of conc. HNO_3 and heat to boiling again. The purpose of the acid addition is to oxidise any iron which may be present, and which must be removed before titrating for the determination of the zinc; if the iron were left in the solution it not only tends to give to the solution a bluish colour, and prevents one detecting the approaching end point by the change of colour which occurs, and also gives an unsatisfactory drop test end point, but its presence leads to results being inaccurate, usually too high.

After allowing the solution to cool somewhat after the HNO_3 addition and boiling, make it slightly alkaline with NH_4OH, just heat to boiling again, and filter off the iron hydrate through a No. 1 paper, catching the filtrate in a suitably sized beaker for titration, such as a 500 c.c. conical one. The filter paper is washed several times with hot water. The filtrate should now measure about 150 c.c.s., if not dilute it to approximately this volume (*i.e.*, the same volume as the standard). Add a small piece of litmus paper to the solution and then *just* acidify with dilute HCl, add two drops in excess. Heat the solution to 80 deg. C. (measured) and then titrate with the potassium ferro-cyanide, exactly in the same manner as the standardisation was made. The c.c.s. of ferro-cyanide required multiplied by its zinc equivalent per c.c., divided by 2, equals the zinc per cent.

The Use of Cast Iron for Retorts for Low Temperature Carbonisation.

By Our Engineering Correspondent.

There is no need to emphasise to-day the growing interest in the low-temperature carbonisation of coal, and this subject—especially as regards the preparation of solid smokeless fuel—has always been associated to some considerable extent with foundry work. Thus, for example, Thomas Parker, one of the chief pioneers of "Coalite" fame, was himself a foundryman of the most remarkable character, and, in fact, it has been stated that his genius for foundry work was one of the chief troubles of the process because he would insist on casting retorts of such intricate design that they were not a practical proposition from the foundry point of view.

Low-temperature carbonisation is, of course, a very complicated subject, but certainly in Great Britain one of its most interesting aspects is this preparation of smokeless fuel, which, to express the matter simply, may be stated to consist of carbonising the coal at say 900-1,100 deg. Fah. so as to leave 10 to 12 per cent. volatile matter in the coal, instead of heating under very high temperature conditions of something like 2,000 deg. Fah. as in the gasworks and coke-oven industries, giving coke with less than 3 per cent. volatile matter and quite different in properties, being non-free-burning.

In order to carry out this operation of low-temperature carbonisation, controversy has long raged as to the best type of retort to use. The advantages of cast iron are, of course, numerous, including a much better rate of heat transmission, ease of making any desirable shape in the sense of offtake pipes, manhole covers and supporting rings, and particularly the fact that cast iron is air-tight and gas-tight, which is not the case with fireclay. This, perhaps, does not matter so much in gasworks or coke-oven practice, but in many sections of low-temperature carbonisation it is a very serious defect because the gas leaks through the pores of the fireclay and burns in the combustion chamber, with the result that it is impossible to regulate the temperature accurately because of this indeterminate factor.

On the other hand, the objections to cast iron are that it has a great tendency to oxidise and scale off under continuous conditions of a temperature like 1,000 deg. Fah., while also it possesses the highly objectionable property of "growing," that is, becoming permanently distorted in shape.

The "Coalite" process, for example, during its long history has changed about several times from cast iron to fireclay and vice versa, while a large number of other processes have used cast iron, including to-day the "Tozer" process, now working at Ballengeich in Natal, the "Hird" method, and the "E" retorts of the Fuel Research Board, in connection with which a large battery of retorts is now to be erected in London. In the early days of carbonisation cast iron was used not only in the gas industry but also for the carbonisation of shale and of lignite, but eventually, somewhere about 1849 in the gas industry, cast iron was definitely superseded by fireclay, since the former would not stand, without ruinous upkeep, temperatures of, say, 1,300-1,400 deg. Fah., with a consequent low yield of gas.

Low-temperature carbonisation, however, is a different proposition, and in this connection it is very interesting to note that strong claims are now being made on behalf of the cold-blast pig-iron made by Messrs. Robert Heath and Low Moor, Ltd., at their Low Moor Works, as is well known. This is being used, for example, in constructing a retort for one of the latest processes and it is maintained that the well-known dense and tough character of cold-blast iron will overcome the difficulties, especially since there is no objection in the way of actual casting, which is not the case with many special pig-irons having other metals added, such as chromium, to reduce the resistance to growth.

There seems little doubt that sooner or later low-temperature carbonisation is going to be one of the most important industries in civilisation, and if any type of cast iron can be used for the retorts there is no need to emphasise what this will mean to the foundry industry, so that the results, as regards cold-blast pig-iron, will be awaited with great interest.

Grids Used in Moulds and Cores.

By Ben Shaw.

A grid may be defined as an internal metal skeleton of a mould, part of a mould, or of a core, used to reinforce the sand, either in order to facilitate lifting, as in the case of cores and drawbacks, or to give it the requisite strength to withstand the pressure of the metal. The grid should be as close to the face of the sand as is practically possible, but it should not be too near, otherwise it may interfere with the release of gases or act as a chill on the metal. If, on the other hand, the grid does not follow closely the shape, instead of giving strength it may actually be a weakening factor. Certain essentials must always be borne in mind. The grid should be rigid enough not to bend or spring, but at the same time it is necessary to bear in mind, especially with steel and the non-ferrous metals, that the mould or core should, at least partially, accommodate itself to the high contraction of the metal, otherwise the resulting casting may be fractured or warped. Generally speaking, more clearance should be given when the grids are to be used for castings in which there is considerable contraction, and in many instances the rigid cast gaggers can be profitably replaced by wrought iron, which, while giving the requisite rigidity, will give to the strain of the casting when cooling to a normal temperature. The experienced craftsman always makes the grids as light as is consistent with strength, in order that the core or mould section may be more easily handled and the casting more easily fettled.

The cheapest grids are naturally those made of cast iron, but they are not always the best, nor is it always possible to make them wholly of cast iron. When the metal of which the casting is to be composed has a high co-efficient of contraction, when the shape of the mould or core to be carried is very intricate, or when a core is large and almost wholly surrounded with metal, the grids may be made either wholly or partly of wrought iron. In many cases a combination of cast and wrought iron gives the best results. Wrought iron lends itself to any modification that might be necessary in following the contour of the mould or core. The moulds for certain types of castings require to be eased as soon as the metal poured into them has solidified, and the grids for work of this class must have special attention. An important consideration when designing grids is their release from the castings after cooling. It is not difficult for a novice to make a grid when he is familiar with the elementary principles, but it may be exceedingly difficult for him to make one that the dresser can get out. A large core may only have one or two small apertures to the outside; indeed, in some cases special holes have to be arranged, which may or may not be plugged subsequently, and which would be quite unnecessary were it not for the core. In such cases the outlet holes are made as small as possible, and unless the grid or grids are made so that they can be easily broken in the fettling shop, damage may be done to the casting. In some instances, when no apertures are required through the thickness of metal, the grids are not removed, the holes cast in for venting purposes being tapped and plugged without having the whole of the core or grid removed. In some exceptional cases this practice is permissible, but, generally speaking, it is bad practice and increases the weight of the casting unnecessarily. When the area of outlets is small the grid needs to be lightly constructed in order to reduce the labour involved in its removal from the casting. It may be necessary to make the grid in several parts, joined together by one or two bars. All grids for cores or mould sections, and indeed all metal supports of sand, should be coated with clay-wash so that the sand will adhere to them. Staples are almost invariably required to be cast in grids for lifting purposes.

A good deal of initiative is required in designing suitable grids. The size and weight of the core or mould section must be considered, the positions and length of gaggers necessary, the best positions for staples to ensure good balance when lifting, and whether the grids are to be used for moulds to receive steel, iron, brass, or aluminium. So important is the question of grids considered that in some foundries the foreman decides upon their design; generally, however, a leading hand is responsible for their design, excepting for less important grids, which are usually left to the individual coremakers or moulders.

In the majority of foundries, particularly jobbing foundries, one or two men are usually made responsible for making all grids required, and in this way proficiency is acquired that enables them to be produced at much less cost than when left to the individual requiring the grid. In even the smallest foundry there should be some part of the floor set apart for grid making. An open sand bed is almost invariably involved in which the impression of the required grid is stamped. In addition to lining off the shape of the grid, the designer is responsible for requisitioning any staples or other irons that may be required to be cast in the grid, and they are inserted at his discretion, but the actual stamping of the grid mould is done by the men in charge of the bed; they simply follow the lines indicated and use a stamp of such a size that will give the necessary strength to the grid. Numerous sectional shapes or part patterns are preserved by those responsible for the bed, in order to assist in forming the various shapes desirable. At one time a template was made for almost every grid needed, but, although still used in special cases, the use of templates is not now depended upon so much as formerly, because, with the aid of trammels, a straightedge, a square, and a knowledge of the fundamental principles of geometry, the majority of grids can be marked out without their aid.

The Quantity Production of Castings.*

By A. S. Beech.

There is no doubt that foundrymen have to face difficulties if they are to break down antiquated ideas and conventions, but it is obvious that if this country is going to recover its old-time supremacy amongst the manufacturing nations of the world, many old prejudices must go and founders must embrace quantity production ideals. To do this the manufacturers themselves must embark on a more progressive policy and accept the standardisation of their product and refuse to pander to the whims and fancies of individual purchasers who ask for special modifications to the product, whilst, the workers, skilled, semi-skilled and unskilled, must do their part to give their entire support and whole-hearted assistance to output. Labour-saving machinery must be introduced wherever possible, and the cost of electricity, whether the government scheme is successful or not, must be brought to the lowest possible level, and finally, good and fair wages must be paid.

Piece-work or output bonus are inevitable for such a scheme, and rates should never be cut, except under exceptional cases, and in such cases the men themselves should have the right to discuss the matter with the manager or owner, and in case of dispute arising this should be settled by a committee composed of workmen and masters. Loss of the contract is preferable to a strike or ill-feeling between the masters and men.

If foundrymen are to adopt these schemes, which have proved themselves so successful in practically all trades in America and in the British motor trade, the first and vital need is a better individual feeling between employees and employers.

Many foundrymen will insist at once that the difficulties of standardisation and quantity production in the foundry are manifold, that the "bugbear" of transport is too great to overcome, that British conditions are vastly different from those obtaining in U.S.A., and that quantities here are not sufficient to permit general acceptance of quantity production.

Given the will, the capital, and the hearty co-operation of all parties concerned, the author is convinced that in almost every foundry where repetition or standard work is carried out, the quantity production ideals can, as a practical matter and not as a dream, be installed and satisfactorily worked.

Lowered Price Increases Potential Buying.

Further, it must not be forgotten that when once a foundry produces and sells its castings or finished articles cheaper, it at once opens up a new field of potential customers, thus increasing the demand for the article, be it luxury or necessity. This is an undeniable fact, confirmed by Mr. Henry Ford's statement to the effect that every time he reduced his price by even £5 or £10, a new number of clients were able to buy his product. Thus it only needs courage and foresight on the part of the manufacturer and confidence that his employees will back him up if he installs expensive plant for labour-saving and high production, to bring this ideal into actual practice.

In making these statements, of course, no reference is made to the purely jobbing foundry, which only produces one or two castings from one pattern. Even in such foundries quicker production could be obtained by the intelligent use of up-to-date apparatus, but confining consideration for the moment to the larger problem of the repetition foundry, it is now proposed to offer suggestions for increasing output so as to give a better standard of living to the men, more profit to the concerns and a more general prosperity to the foundry industry.

Actual proof of what has been done in England towards this ideal, is available, for the continuous casting of gas stoves and fire-place parts has been in actual operation and has given every satisfaction at the works of Messrs. Sidney Flavel & Company, Limited, of Leamington Spa, for some years past. In these works the sand is conveyed automatically to the moulding machines and the moulds are conveyed by automatic conveyors to the pouring point and afterwards travel along the runway until solidification takes place, when the casting is taken from the box, the sand falls down a grid and is conveyed by means of a belt back to the sand-reviving plant, and the boxes are taken back to the machines.

A similar installation is now being erected at another large works in this country, and it is hoped that this will be ready in the very near future. This company is making a practically standardised article, but it also has difficulties to overcome, such as alterations to patterns, etc., to suit clients' fancies, but they have found that with a little good-will on both sides, these do not seriously upset their calculations and the plant operates satisfactorily.

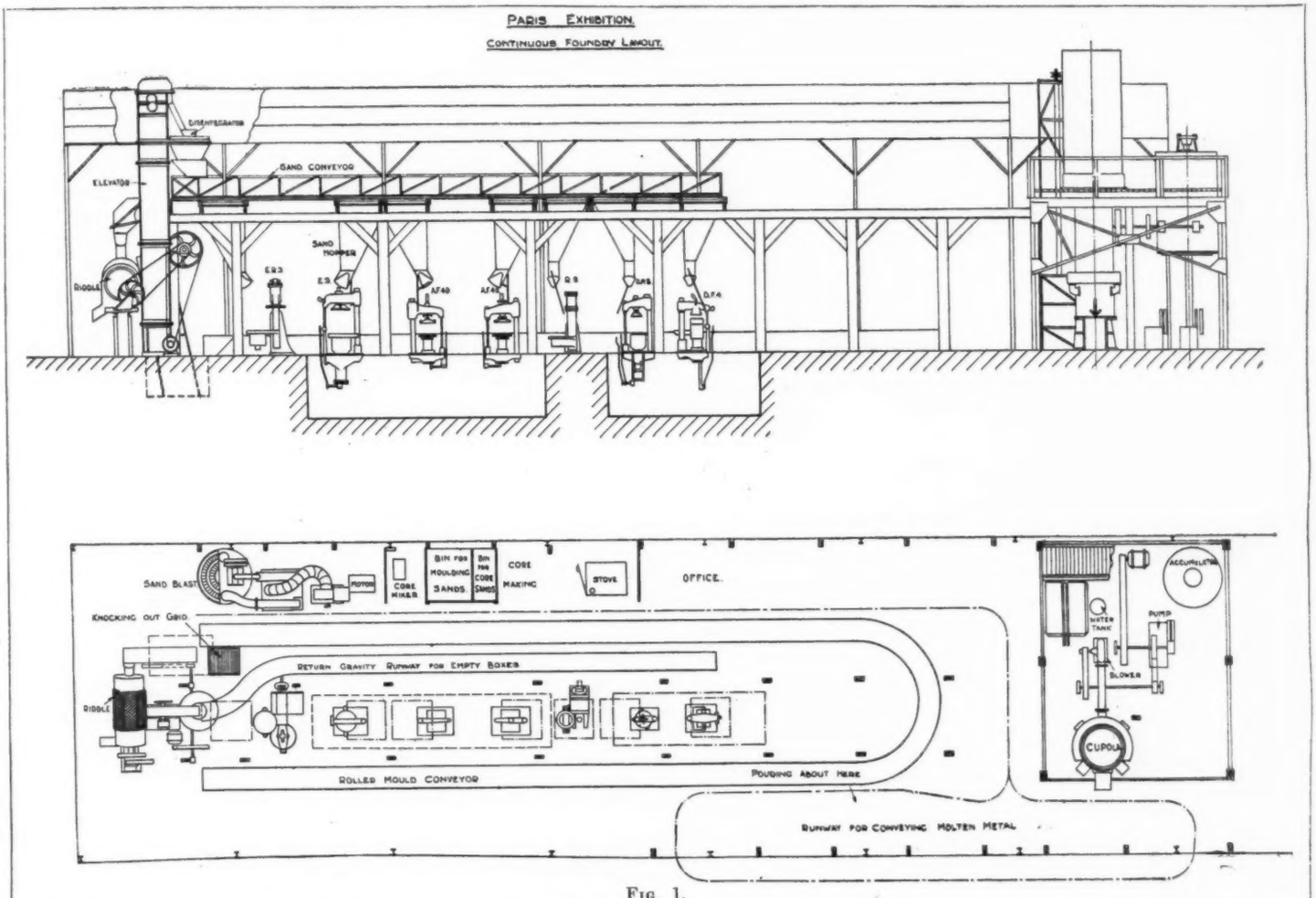


FIG. 1.

* A Paper presented to the Middlesbrough Branch of the Institute of British Foundrymen, Mr. F. P. Wilson presiding.

German Progress.

In addition, it will be remembered by visitors to the recent Foundry Congress and Exhibition in Paris, in September last, that several French foundries have commenced to put into operation the continuous casting scheme—Citroën, for instance. There are many other foundries in France who are also adopting lay-outs of this description, and Belgian foundries are also taking up the idea at a very rapid rate. A report recently issued by Mr. J. W. T. Thelwall and Mr. C. I. Kavanagh, British Commercial Secretaries at Berlin, on the economic and financial conditions in Germany to July, 1927, states:—

"A retrospect of German labour conditions does not reveal any of those costly interludes of industrial interruption which go to sap the vitality of the reconstructive effort so necessary to make good the ravages of war and to take account of modern manufacturing methods and the new direction of international competition. In the absence of any substantial external assets the necessity to exploit to the full every natural resource and to produce rationally has been grasped, and out of the realisation that it is only by application, hard work and efficiency that she can win through, Germany has set herself sternly to the task, and her chief assets of rehabilitation, labour, technique and industrial efficiency, have been expanded to the utmost.

"In Germany the intensity of the post-war industrialisation, and standardisation cannot be exaggerated. A complete change has taken place in the ideas governing the application of new and more efficient mechanical equipment. The old conservative tendencies, which at one time formed such a deep contrast between American and European methods, have almost totally disappeared.

"The attitude of labour to the introduction and service of labour-saving and speeding-up machinery is one of understanding, and Germany has passed through a phase of industrial adjustment which has contributed in great measure to her astonishing recovery from the reactions of the war, the chaos of inflation, and the many disintegrating forces to which these gave rise.

"It cannot be denied that Germany has won back the essentials of financial credit and commercial confidence, and is well on the way to a larger recovery. The spirit of enterprise is everywhere apparent, and even during very stressed financial conditions which have recently prevailed, one cannot perceive any slackening of the effort to build up efficient plants or any hesitation in expanding upon new lines. Germany has practically made good the losses in steel occasioned by the severance of her former properties in the ceded territories—a truly remarkable performance."

The activities in these three European nations are dealt with because they are without doubt Britain's chief competitors on the Continent of Europe, and it is as well for us to realise what competitive nations are doing.

An Exhibition Lay-out.

An installation erected by S.A. des Ets. Ph. Bonvillain and E. Ronceray, of Choisy-le-Roi, France, as a stand at the recent exhibition held in Paris in September last, presents features of interest. Fig. 1 shows the general arrangement of the stand, from which it will be seen that there were seven machines in position in the centre of the mould conveyor. These machines were making different classes of moulds, varying from 22 in. × 32 in. × 10 in. deep, with boxes, to 17 in. × 12 in. × 4 in. deep without boxes. It is possible and easy to make with the same sand and mould conveyor, and different sizes and classes of moulding machines, castings of varying depths, sizes and shapes. It will also be seen from Fig. 1 that the sand was elevated and conveyed to the hoppers over the moulding machines. The operator of the machine pulled a handle and the sand fell automatically into his box. The pressure on the mould was then applied, and the pattern drawn. The moulder then turned round and put the mould made on to the mould conveyor. The two first machines, marked ER3 (roll-over) and E3, were working as a single unit, that is the ER3 was making the lower half of the mould and the E3 the top part of the mould, so that the operator from the E3 machine assisted the operator from the ER3 machine to set cores, carry and close the boxes. The same conditions prevailed in the case of the two AF40 (shallow stove plate machines) and the R5 and O.P.5 machines, but in the case of the DF4 machine, which rams the top and bottom moulds simultaneously and then pushes the mould through the boxes (the boxes being part of the machine), one operator was sufficient.

Off each set of machines shown, the production was very easily one mould per minute, with the two operators for the pairs of machines and one operator for the DF4 double ramming machine. The moulds having been put on the mould conveyor, of the ordinary roller type, over the rollers of which was an endless chain with triggers on it, they travel towards the cupola end of the stand. In this movement triggers engaged in a small catch on the underneath side of the mould-conveying plate, which was fitted with skids, in order to permit of an easy and steady passage over the rollers. The sizes of these plates were slightly larger than the largest size of mould which was being made, and hence would accommodate any size of mould made on the machines in the lay-out.

The moulds thus travelled along on their plates to the end of the straight length of the conveyor, which is quite close to the cupola, which was in actual operation, melting iron. The moulds were poured on the conveyor at this point and then travelled on slowly round the loop shown in the slide and down the other straight length on the top side of the illustration. During their travel, new sand to the required quantity and a small quantity of water was put on the top of each moulding box. When the moulds arrived at the extreme end of the convevor, they were opened, the casting extracted and handed over to the fettling department shown, and afterwards sand blasted. The sand, together with the addition of new sand already mentioned, was knocked out of the boxes over the shake-out grid shown, and was taken by the elevator under the ground and lifted into the revolving barrelled shaped screen shown in Fig. 1. In this, it was freed of scrap and passed out of this screen into a further elevator, which took it to the top of the stand, where it fell by gravity into the disintegrator, shown in position, and after being thoroughly disintegrated it fell again into the sand conveying trough, and by means of the sand scrapers, was redistributed into the various sand bins, situated over each machine, ready again for use.

The moulding machines were all worked hydraulically from the accumulator shown on the left-hand side of the stand, which was operated by a 3 h.p. pump, and which was more than sufficient for all the seven machines. The machines were all pressure type. The latest type of down-sand frame, is a very simple but probably one of the most valuable assets to the mechanical moulding of recent date, The down-sand frame, or the "rehausse inferieur" as the French people call it, is to put it simply, just a frame containing the necessary excess of sand needed for compres-

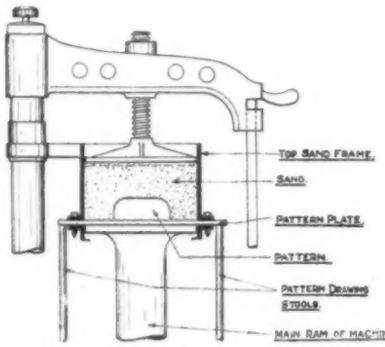


Fig. 2.

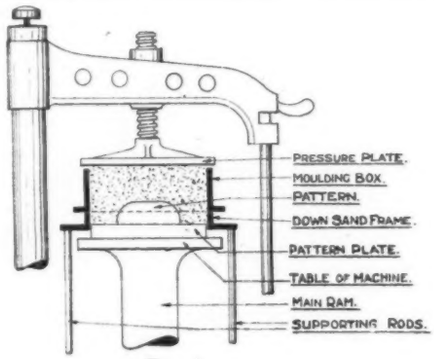


Fig. 3.

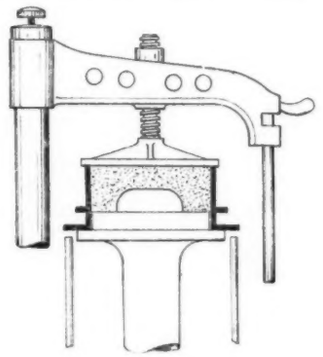


Fig. 4.

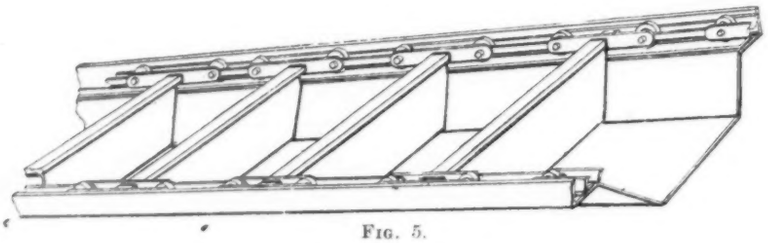
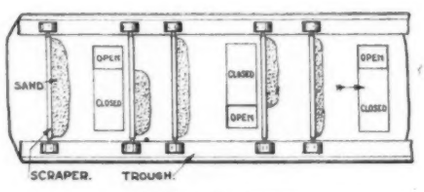


Fig. 5.



Plan View of Sand Conveyor.
Fig. 6.

sing the sand to the required degree of hardness, and is placed round the pattern plate and above the joint line. These have speeded up the machines by at least 20 per cent. at a minimum estimate.

Fig. 2 shows the ordinary method of mechanical ramming by squeezing; the pressure plate, as shown, entering the box through the top sand frame and pressing the sand into the pattern. To draw the pattern the four rods or stools, two of which are shown on the diagram, and which are connected by means of brackets to the top of the pattern drawing piston, lift the box away from the pattern plate.

Fig. 3 shows the same type of moulding machine, but in this case it is fitted with no top sand frame but with the new down sand frame. It will be seen from the illustration that the table which is

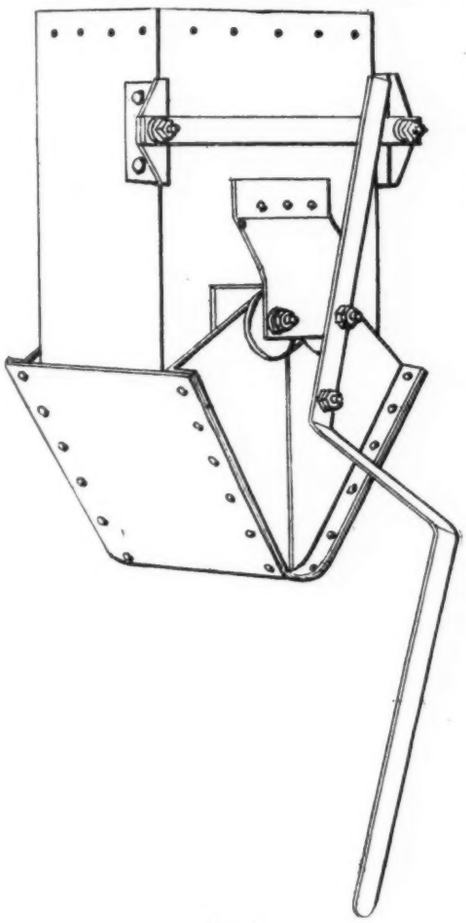


FIG. 7.

lifted by the main pressure piston carries the pattern plate. Around this, with adjustable studs to regulate the height, and above the joint line of the pattern plate is the down sand frame.

The ears or lugs of this down sand frame, when the machine is not in operation rest on the four adjustable rods, two of which can be seen on the illustration. It will be evident that if the down sand frame is lengthened there will be a greater quantity of sand to compress, whereas if it is lowered there will be less. Thus it is very easy to arrive at some definite position so as to ram all the moulds to the same degree of hardness continuously.

Fig. 4 shows the machine under pressure, and it will be observed that the table has ascended, pushing the pattern and the excess of sand through the down sand frame up to the joint line, the top plate does not enter into the mould in this case, and thus provides a definite stop for the box in the ascent. If there are any bars in the box these are solidly rammed underneath without any hand tucking, because the pattern is being pushed upwards against the under-side of the bars, thus the bars are making ramming plates for themselves. It will also be noticed that the pressure applied to the mould is harder near the joint line, and is less hard at the top side of the mould. In other words, it will be seen that ramming with the down sand frame means that the pattern is pushed into the sand, instead of the sand into the pattern, as is the generally understood method. This, to the author's mind, is preferable to any method of jarring the mould, being much quicker and resulting in more uniform ramming.

As soon as the piston is put to exhaust, the table carrying the pattern plate descends, the pattern plate receding again through the down sand frame, and the pattern is drawn. The approximate time for actual ramming and pattern-drawing on a mould about 24-in. square is approximately 6 to 7 seconds. Probably such a speed represents nearly the limit as far as actual moulding and pattern drawing is concerned, and the main interest now is to save time and fatigue in getting the sand into the boxes, and the boxes on and off the machines.

Reverting to the sand conveyor shown on the general lay-out, which is termed a "Flight" conveyor. This is composed of a trough in which scrapers or pushers work, as shown in Fig. 5. These scrapers are running on wheels and by means of link-chains on the top ledge of the trough, thus ensuring easy and rapid movement. Further, these scrapers push the sand along the trough until the opening to the hoppers is reached, when the sand falls into the aperture provided and is then in position to be used by the operator.

Distribution of the Sand.

Fig. 6 shows the sand being pushed along the trough. Obviously if the opening above the first bin was completely and permanently open, all the sand would fall into the first hopper or bin and the second and following hoppers would have to wait for a supply of sand until the first one was full, and so on, and the operator at the last machine would have to wait a considerable time for his supply. A simple but ingenious method was therefore devised for overcoming this trouble. On looking down on the trough in Fig. 6, the aperture leading to the first hopper is only partly open, and, moreover, at one side of the trough only. The sand is pushed completely along the face of the scraper or pusher, until it comes over the top of the open part of the trough, where naturally the portion of sand with no support under it, falls into the bin. The rest of the sand then travels forward along the length of the trough and the tendency is for the sand to re-form itself along the entire face of the scraper or pusher, until it comes to the second hopper; and as the opening to this hopper is on the reverse side of the trough to the first one, so this time the body of sand at the other side falls. Thus it continues on until all the hoppers are full, when the sand falls over the end of the trough. When this happens the conveyor may be stopped until more sand is required, but in ordinary practice it is found that the conveyor will very seldom be stopped as the sand is being very rapidly used by the moulding machines below.

Figs. 7 and 8 show arrangements complete with handle so that the operator can obtain the required amount of sand easily from the hopper situated above the machines, and it will be seen that the mouth of this arrangement easily opens and closes, thus it is able to stop the stream of sand coming at any given moment.

The mould conveyor used on this exhibition stand was the ordinary roller type conveyor, except that a chain with fingers was driven over the rollers at a slow speed to push the mould-carrying plates forward along the conveyor. The conveyor up to the pouring point or the end of the straight length was quite flat, so that in this case there was no need to fear one mould running into the back of the other, and breakage of moulds or dislocation of cores taking place. Moreover, as the mould-carrying plates were provided with ample skids underneath, there was no danger of the moulds being broken from vibration. Several other types of mould conveyors, either of gravity type or of chain-driven types, have been recently designed and patented in this country, in order to prevent any moulds colliding before they reach the pouring station. The type shown in Fig. 9 provides for gravity, and might be termed a gravity-timing device. The first mould is put on the conveyor and is arrested by the elevated triggers shown in Fig. 9. When the operator is ready to put on the second mould he turns the handle shown, half a complete revolution, when the first triggers descend and the second set ascend, thus allowing the first mould to run along, but at the same time providing a space between the first and second moulds (and so on up to the pouring point), after which ordinary gravity rollers can be provided.

Fig. 10 shows another type of roller conveyor which can either be used flat or sloping, according to the conditions, and in this case it will be seen that endless chains with triggers are provided, these triggers being removable, so that they can

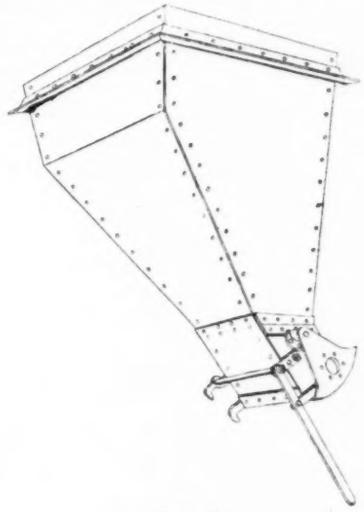


FIG. 8.

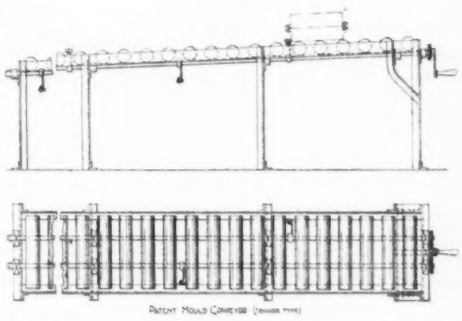


FIG. 9.

be spaced at any distance between each other to accommodate the moulds to be moved. The apparatus is worked by the handle shown, or can be driven by an electric motor at a slow speed or geared to run slowly.

The lay-out for the exhibition shown in Fig. 1 must not be accepted as one altogether suitable for working in a foundry. It was simply erected to demonstrate the great possibilities of continuous pouring and quantity production. Certain conditions, however, had to be taken into consideration, the main one being a lack of space.

In a foundry lay-out there is no doubt that a special sand plant must be installed. At the same time much valuable information and guidance can be obtained from this exhibition lay-out, amongst which is the very important point that on the same unit different sizes of moulds and classes and weights of castings were satisfactorily dealt with. Fig. 11 shows the sand plant designed for a large Spanish railway company, and which is designed to be built into a continuous casting unit. Whilst the unit at the exhibition worked well it would have been greatly improved by the inclusion of such a sand-preparation unit. Fig. 11 shows the sifter on to which the sand is deposited, in order to get rid of the scrap and refuse, which are thrown out under-

neath. The sand falls into a pit and is then elevated, in the elevator shown, into the large storage bin, under which is a specially designed apron-feed conveyor. Fig. 12 shows the other side of the plant, the apron feed deposits the sand into the automatically-discharging mill, and eventually the sand is automatically discharged into

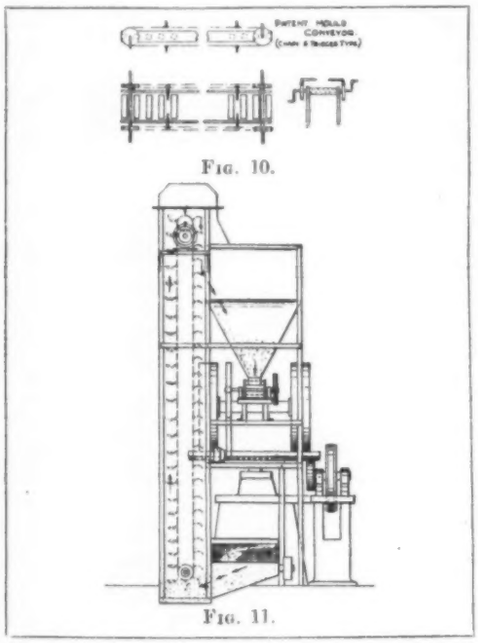


Fig. 10.

Fig. 11.

the mouth of the sand disintegrator, and finally it would be elevated up again into the flight conveyor for distribution into the sand hoppers over the machines.

Fig. 13 shows a lay-out for a foundry now in actual state of erection, and provides an interesting study from the continuous casting point of view. The moulding machines shown represent three types of hydraulic roll-over standard machines, and three types of standard pressure machines. It will be seen that the machines making the lower halves of the mould are placed

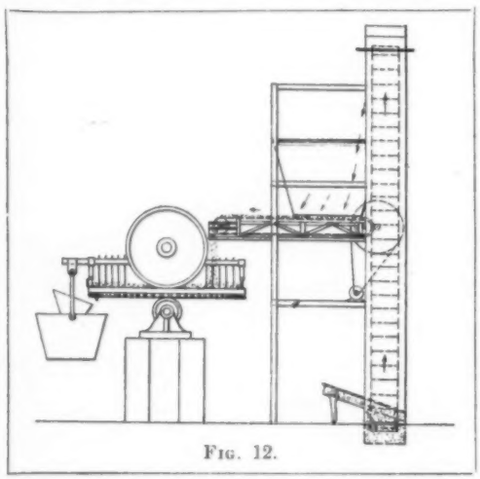


Fig. 12.

together, that is to say, there are three drag machines all together, making the bottom halves of the mould. This is done so that men can be situated on the outside of the conveyor so that any core setting may be accomplished before the bottom halves of the mould reach the machines making the top halves of the mould. In the exhibition lay-out shown in Fig. 1 it is not possible to make this arrangement, due to lack of space, but it will be quite evident that this is a much better arrangement. The closing of the boxes can be made whilst the moulds are passing the cope or top part machines.

A Spanish Lay-out.

The conveying installation is composed of a roller transporter of a "U" shape, at the extremity of which is found a knock-out grid, where castings are taken out of the mould for transport to the fettling shop. The boxes are returned by the transporter shown and the bottom carrying plates are also returned on the roller transporter shown on Fig. 13. The sand which has been knocked out of the box is elevated by a belt at the end of which is a magnetic pulley, and the sand falls immediately into the riddle shown, which separates the small particles of core and any foreign matter. After passing through the riddle, the sand falls into the elevator, and from the elevator into what we call a regulating bin, over the top of the sand mill. From the sand mill the sand is automatically discharged through the disintegrator and then into the second elevator which conducts the sand again into the flight conveyor shown in the illustration. The flight conveyor then distributes the sand round the bins in the same manner as previously described. It will be seen from Fig. 13 that this lay-out is a

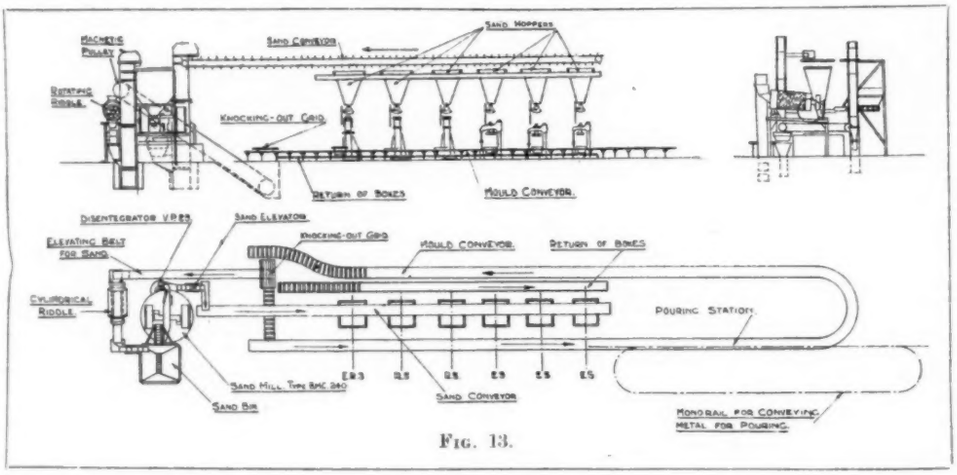


Fig. 13.

complete unit, that is to say, it provides for the conveying and distribution of sand, the moulding, the conveying of the moulds, and also for the actual pouring on the mould conveyors, for the knock-out, for the re-preparing and reconditioning of the moulding sand, and for the mechanical re-transportation of the sand into the hopper situated above the machine; and the author's estimate of moulds to be produced from such a lay-out would be somewhere in the region of one mould per minute per machine and per labourer. With regard to the personnel for working such a unit, it is suggested that one man for each machine, that is, six men moulding (one on each machine), two men setting cores and closing, two men pouring, and two men knocking out and sending the castings by the conveyor to the fettling shop; thus with twelve men, and with an installation such as has been shown, a production of approximately six complete moulds per minute could be produced. It must not be forgotten also that this lay-out will take very little room, and that the actual floorspace in the foundry will be used very many times during the day, consequently it must be expected that the overhead charges will be correspondingly reduced, as well as considerably increasing the output.

An aspect of the question, however, which must not be lost sight of is the commercial one, and this, of course, is the side which must be the careful study of the management. It may be said that if the plant outlined gives the estimated output, mentioned previously, the disposing of the production at a price to show a reasonable amount of profit remains to be discussed. It is quite common to find large companies languishing for orders. Very often one finds such firms soliciting and accepting orders for castings at a low rate, and, in some cases, simply to cover overhead charges until their own trade should improve. This, however, is a bad policy for several reasons:—

(1) It is unfair competition for the unfortunate general foundry, whose sole business is to supply castings at a reasonable rate of profit, and who do not make castings for their own use.

(2) When trade does improve with the firm in question, the improvised or stop-gap order is discarded, and the purchaser may find he is getting an insufficient supply of castings, so that is bad from his point of view.

(3) The probability is that such a state of affairs results in price-cutting, and, possibly, rate-cutting on piece-work prices, so this is bad for the workpeople.

So that from all aspects such business is poor for everybody concerned. It may thus be stated that I am suggesting that in times of depression foundries who exist to supply their own works with castings for any definite article should close down.

In making the following statements and suggestions it is desired to emphasise the fact that when trade is slack it is folly to be inactive. Conversely such a situation merits activity, and if the staffs controlling the various trades in this country had a little more imagination, there would be more men employed. It is useless to depend on either Government or politicians to show us a way to prosperity, and, undoubtedly, the remedy rests with the manufacturers themselves, and the first thing to do is for the producer to endeavour to estimate for himself the approximate consumption of his particular product in the markets he is out to capture, or where he is already doing business for, say, six or twelve months ahead. To do this successfully he must reduce his various patterns or types and range of sizes to a minimum. After arriving at this conclusion, he should then give orders to all the departments, foundry, machine shop, and assembling shop to proceed with the total quantity which he has estimated he can sell during the six or twelve months to come. Obviously he must cut his costs, and consequently his selling prices, by the quantity of production of his product, and not wait for the actual orders to come along. There is no doubt that by adopting such a procedure, and it will require courage, he will not only be able considerably to reduce his costs, but he will also be able to pay his men better wages, and he will capture markets from which at present he is excluded by reason of his costs in comparison with other foreign countries.

The fact that the producer pays better wages alone means an improvement in trade in this country; America has proved this conclusively. It is an acknowledged fact that per head of the population they have the finest domestic market in the world. If Mr. Morris' business methods were adopted for the manufacture, say, of electric motors, flat irons, stoves, wagons, or, in fact, any article for which there is any real demand, it is natural to expect that the same prosperity would be extended to these trades.

DISCUSSION.

In the discussion which followed, Mr. T. E. Bashford pointed to the fact that Mr. Henry Ford was the originator of mass production. What was his position to-day, he asked.

MR. BEECH replied that taking the motoring industry as a whole they found that manufacturers were very busy. The reason Mr. Ford was not busy in this country was because we had some bright people in the motoring trade who had also adopted mass production.

MR. H. TODD pointed out that the safeguarding or protection of the motoring industry had led to its success. In addition to this, motor manufacturers had a systematised job which was carried out by the firms themselves. He did not think many other sections of engineering had anything like the same chance. In America they did not wait until orders came in; they made the stock and put it on the market. In England we waited for the orders coming in, and then acted accordingly. In his opinion if mass production was to be brought about it must start from the foundation—the designers.

MR. J. HACKWOOD said thousands of pounds had been spent by manufacturers to simplify manufacture and help production, and then it was found that the consumer wanted this or the other design. Very often it had been money thrown away.

MR. BEECH replied that one of the first things in mass production was standardisation. He was afraid manufacturers were to blame for the mess we found ourselves in to-day. They did not make themselves adaptable. To illustrate his argument Mr. Beech referred to the production of mincing machines. A British manufacturer found that the Americans could beat him, and so he went over there and studied production. He came back to England, and the first thing he did was to make 100,000 machines, and before the end of the year he had cut the Americans out of the market. Nearly all the mincing machines sold to-day were British, and in addition the same manufacturer was selling them all over the world. The article which offered best scope for mass production was that for domestic use. Mr. Beech gave another example of what had been attained by mass production. His own firm invented little pulley blocks. They produced 50,000, and they sold many more in twelve months.

MR. BASHFORD pointed out Tees-side was essentially an iron and steel area, and he thought mass production would tend to localisation. He instanced the mass production of railway chairs, and said if all the work was given to one district another area would have to go short. Mass production would be workable in respect of the domestic article, but for general engineering he did not think it would be helpful.

MR. BEECH did not think it likely they would get localisation as had been suggested. They had firms making gas stoves in Leamington Spa and in Scotland. What they wanted to aim at was the standardised article. It was perfectly insane to have so many specifications for wheels used at collieries. Engineers had their own particular ideas, and it did not give manufacturers a chance to standardise an article. There was undoubtedly a tendency on the part of railway companies towards mass production.

A MEMBER said one of the drawbacks to production was the fact that standards were being often changed.

MR. BEECH agreed that it was not a business-like policy to keep changing the standards, and in dealing with further questions said multiple moulding was losing favour. He had seen mowers produced on the mass principle. As showing the value of mass production, Mr. Beech pointed out that on one occasion he wanted a 3-h.p. enclosed motor. He got a price from a British manufacturer—£39. He obtained one from a French firm for £19. This manufacturer made a certain number of motors, and he told his customers—"That is my motor, take it or leave it." He was as busy as a bee.

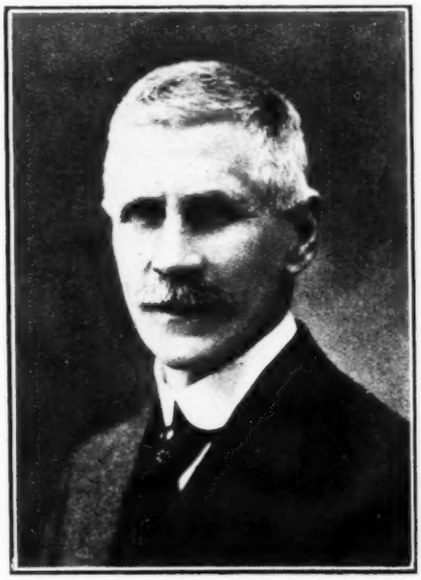
MR. TAYLOR and MR. C. MCCUSKER contributed to the discussion, which was closed by MR. F. P. WILSON, chairman, who said if they wanted to create trade they must produce a cheap article to attract buyers. He thought the mincing machine was a happy example of what could be accomplished.

Replying to a vote of thanks, MR. BEECH said America could teach us a great deal in mass production. If we used a little imagination we could bring prosperity to this country.

I.B.F. Branch Presidents.

No. 7.—Lancashire.

Mr. J. S. Glen Primrose, A.R.T.C., C.I.Mech.E., who has been appointed President of the Lancashire Branch of the Institute of British Foundrymen for this session, is a native of Glasgow, where his early training was received at Allan Glen's School. He later received a business training in that city, and completed his chemistry and metallurgy course at the Royal Technical College, of which he is an associate. On becoming chief assistant to Emeritus Professor A. H. Sexton, of the metallurgy department in the College, he assisted in inaugurating large foundry classes over twenty years ago, and it was from these that the earliest recruits were drawn in the formation of the Scottish section. Mr. Primrose studied electrical engineering as a post-graduate course, and holds



MR. J. S. GLEN PRIMROSE.
(President of the Lancashire Section of the I.B.F.)

the full technological certificates in electro-metallurgy as well as iron and steel manufacture from the City and Guilds of London, of which he is an honours medallist. He studied engineering and mining at the Glasgow University, and later did important research work at the Freiberg Mining Academy, under Professor Friedrich, chiefly connected with the use of ultra-violet light in metallography. His book on "Practical Metallography of Iron and Steel" is well-known, in addition to his work, in collaboration with Professor Sexton, on the "Metallurgy of Iron and Steel," "The Non-Ferrous Metals," "Principles of Ironfounding," "Alloys," "Producer Gas," etc. He has been a frequent contributor of Papers to various Branches and conventions of the Institute, chiefly concerning himself with the practical applications of metallography and testing machines to the foundry. Since leaving the academical sphere, Mr. Primrose has been connected with a number of well-known English engineering firms in the capacity of chief metallurgist and testing engineer, having special concern with the foundry sections covering both ferrous and non-ferrous alloys. Within recent years he has been interested in the work of two large concerns in the wire trade, in which the increasing importance of special alloy founding and heat-treatment control are coming to be more fully recognised. Mr. Primrose is an original member of the Institute of Metals, and an active member of numerous other technical societies, to most of which he has contributed Papers on various subjects.

London Foundrymen Visit Peterborough.

The two principal foundries of Peterborough, Messrs. Baker, Perkins, Limited, and Barford and Perkins, recently carried out a scheme which could be usefully followed by other centres. Though having no commercial connections, these two firms acted as joint hosts to the London Section of the Institute of British Foundrymen.

The visitors arrived at Queen Street Ironworks (Messrs. Barford and Perkins) at 10.30 a.m., and were received by Mr. J. E. S. Perkins and Mr. W. Cree. As is well known this firm specialise in rollers, from the heaviest road roller down to the smallest garden roller. A special technique has been developed for moulding the latter. The outside of the mould, as it requires more ramming, is jarred first, then the false core is removed, filled with sand carrying a grid, and re-jarred. Thus the actual mould as apart from the core receives a considerably greater compression. This method certainly gives an excellent surface on the casting. Other factors which may affect the face is the careful milling the sand receives in a sift employing Simpson intensified mixer, and the blacking sprayed on from a "Jimmy" apparatus.

The early arrival gave the visitors a chance to inspect the interior of the Jackman cupola which had not been relined for 18 months. It carried Scotch firebricks, and was patched with Silacene, the method of application being demonstrated by Mr. Cree. This foundry is fortunate in being able to call upon a precision horizontal grinder for the finishing off of box parts. The holes are drilled to a jig, and after 12 months in service they are re-bored and filled with hardened-steel bushes. A very effective demonstration was given of the range of mechanically-propelled rollers of modern design when the latest model of a heavy-weight machine using a combination of wood and petrol as fuel acted the part of a mastiff, whilst a small model used for sports grounds circled round it like a small terrier.

Lunch was served at the London and North Eastern Railway Company's Hotel, when Mr. W. B. Lake, President of the London Section, took the opportunity of thanking the directors of the two firms who had acted as hosts, especially Mr. Perkins, of Barford and Perkins, and Mr. Booth, of Baker and Perkins, the former for having devoted his morning to their interests, and the latter for favours to come, as he understood that Mr. Booth was going to place his services at their disposal during the afternoon. After acknowledgment by both these gentlemen, private cars took the party to the Westwood Works. Here the visitors were first shown the tool room and mechanical-testing department, where much interest was displayed in a machine by the Société Genevoise, which is capable of preparing jigs to an accuracy unattainable by normal methods.

The laboratory, under the care of Mr. Clap, is doing much more than checking the analyses of the raw materials. It is carrying out an exhaustive research on sands. We have never yet encountered castings carrying a better surface, and if the laboratory does no more than maintain this standard it will have accomplished much. The foundry itself can never be highly mechanicalised because of the diversity of the castings produced. Where possible, however, the patterns are mounted on Osborne or Denbigh moulding machines, the former being fed by a Royer sand projector through a conveyor or hopper. In this foundry, in addition to cast iron, small quantities of steel and non-ferrous metals are also melted. The cupola plants both at this works and at Queen Street Ironworks are provided with an exceptionally roomy stage, and whether this is or is not in line with the latest practice, it certainly does result in better cost keeping, and the large covered-in cupola stage should not be ruled out when studying extensions.

The visitors were particularly indebted to Mr. Booth for explaining in great detail, with examples, the methods used for progressing, filing, purchasing, and other phases of business administration.

British Cast Iron Research Association.

Sixth Annual Report.

Strike Costs.

The Sixth Annual Report for the year ending June 30, 1927, of the work of the Association states that in common with other institutions dependent for their income upon industry, the protracted coal dispute, which occupied virtually the first half of the year under review, proved a serious handicap. The difficulties encountered by members in meeting the situation, which necessitated working with unfamiliar imported raw materials in the form of pig-iron and fuel, threw extra work on the staff. The general preoccupation of the business world hampered propaganda work, progress in which had been confidently anticipated in view of the experience of the two previous years, and the general difficulties were responsible for several withdrawals from membership, particularly among small foundries. This was particularly unfortunate in view of the hopes entertained of a fuller response from the industry following the highly satisfactory report made by the Committee of the Department of Scientific and Industrial Research at the end of the first five years' working of the Association.

The last Report recorded the transfer of the Association's Registered Office and Laboratories to 24, St. Paul's Square, Birmingham, although in actual fact the change took place in the financial year now under review. The extra space afforded for the growing work of the Association, and the convenience of having offices and laboratories under one roof, has resulted not only in greater ease of supervision, but in considerable working economy. The whole of the anticipated economies, however, will only be realised in the current financial year, which will be the first complete year under the new conditions. During the year under review double rental charges had to be met for the overlapping period when the alterations to the new premises were being carried out, while costs of power, fuel and light were greatly augmented during the coal dispute.

Experimental Foundry Wanted.

During the year under review expenditure has exceeded income by a sum of £1,071. Except, however, for a sum of £68, this is wholly in respect of expenditure on the new premises, which has been charged to revenue. The Association, like others of its type, has always been handicapped by the fact that it has no capital. It works entirely from income, which it is expected by the Department of Scientific and Industrial Research to expend in its legitimate activities. Only a limited amount of money, therefore, saved from income, is available for capital expenditure. It was the Council's intention when the scheme for centralising offices and laboratories matured, to approach members for contributions to meet the expenditure contemplated, but the general disorganisation of industry owing to the coal dispute made this course inadvisable. At some more propitious time it may be possible to replace the capital cost of the extensions, which have been taken from the slender balance in hand, and to complete them as originally planned. The Council has also felt that the Association cannot regard its equipment as complete until it has a small foundry, and it was necessary to forego this part of the original scheme entirely. It is hoped shortly to make arrangements to rent a small foundry near the headquarters offices, adjacent to the works of a member, from whom arrangements could be made for the foundry labour as and when required. These facilities would make it possible to carry out on a practical scale experimental work which has hitherto not been possible, and to house various gifts of foundry equipment which have from time to time been offered to the Association. It is not intended that the adoption of such a scheme should mean the abandonment of practical work carried on in the foundries of members.

Membership.

The subscribing membership of the Association in all classes is 299, of which the number of ordinary and trade members is 226.

Council.

The Council has again had the advantage of the services of Mr. H. B. Weeks, F.I.C., as chairman, and of Mr. F. J. Cook, Mr. J. T. Goodwin and Mr. Oliver Stubbs as vice-chairmen. Mr. S. H. Russell has acted as chairman of the Research Committee, and Mr. W. B. Parker as chairman of the Publications Committee. To these gentlemen the cordial thanks of the Association are due for the time and energy which they so freely place at its disposal.

During the year five Council meetings have been held, with an average attendance of fifteen. Of the Research Committee five meetings have been held, with an average attendance of fourteen. Ten meetings of Research Sub-Committees have taken place in addition, the average attendance being eight. This marks a decided increase in the number of meetings of sub-committees, and indicates the successful working of the sub-committee system. Two meetings of the Publications Committee have taken place, the average attendance being ten, and three meetings of special committees and sub-committees, with an average attendance of five. During the year the Scottish Committee has held two meetings, with an average attendance of twelve. This was the first territorial committee to be appointed, and does extremely useful work in promoting the interests of members of the Association in Scotland. While territorial committees have not yet been formed in other areas, frequent opportunity is taken by the Director in visiting a particular area to keep in touch with local members of Council. Meetings have been held in London, Birmingham, Sheffield, Manchester and Falkirk.

Internal Organisation and Staff.

In January, 1927, Mr. A. L. Norbury, D.Sc., took up his duties as senior metallurgist, and is actively engaged in conducting and supervising research work. Dr. Norbury comes to the Association with a distinguished record in metallurgical research. He received his metallurgical education at the University of Manchester under Professor H. C. H. Carpenter and Professor C. A. Edwards, and after war service went to University College, Swansea, to assist Professor (now Principal) C. A. Edwards, who had been appointed the first Professor of Metallurgy, to create a metallurgical school in that area. Dr. Norbury subsequently became Senior Lecturer, and was holding this position when appointed to the Association.

Research Work.

On moulding sands considerable progress has been made. A complete schedule of tests for the laboratory investigation has been worked out, and a series of results obtained on typical Bunter sands, such as Kingswinford and Bromsgrove, and on typical Eocene sands, such as Erith. In each case careful samples were taken from different horizons in the quarry, and tests have been taken over a range of moisture contents and densities (degrees of ramming). Furthermore, a complete report on tests of a practical character suitable for foundry use is approaching completion.

On heat-resisting cast irons the behaviour of a number of ordinary cast irons has been studied, and also the influence, in a preliminary way, of nickel and chromium. The investigation is now covering the growth of cast iron of various casting thicknesses in various atmospheres. A useful method of treating ordinary cast iron required to resist heat, by means of aluminium, has been worked out at the Falkirk laboratory.

On malleable cast iron the influence has been determined of total carbon and of rate of cooling on properties, and a lengthy investigation of the influence of silicon is now nearing completion. During the year several foundries in France and Belgium were visited by the Director and Consultant to see the operation of a new type of cupola.

The first report on the equilibrium of the iron-carbon-silicon system, circulated to members during the year, was presented by Dr. Hanson in September, 1927, with the permission of the Council, to the Iron and Steel Institute, the Paper incorporating an entirely new theory of the constitution of cast iron which may have far-reaching consequences. This work was held up after Dr. Hanson's appointment in succession to Professor Turner at the University of Birmingham. Dr. M. L. Becker, who has completed a useful investigation on graphitisation, has recently joined the staff of the National Physical Laboratory, and it is hoped at a later date to complete the work on the iron-carbon-silicon system, as the change affecting Dr. Hanson did not permit the complete range of carbon and silicon contents to be covered.

Work on light castings irons at Falkirk was gravely interrupted by the coal dispute, which interfered more or less with all work involving large-scale melting, owing to the lack of pig-iron and the inferior quality obtained from newly-blown furnaces.

An entirely new investigation was commenced during the year on the influence of nickel on cast iron. This is being done at the University of Birmingham under the supervision of Professor D. Hanson, in co-operation with the Association, which has appointed a Nickel Sub-Committee to deal with it. It is hoped to settle entirely the vexed question of the precise influence of nickel and chromium on cast iron.

Relations With Other Bodies.

The Council has again to acknowledge the courtesy and helpful assistance of the officers of the Department of Scientific and Industrial Research. The Department has recently performed a useful service for all Research Associations by issuing a booklet, "Co-operative Industrial Research," collecting the experiences of the whole of these bodies.

The close connection between the Association and the Institute of British Foundrymen has been maintained, and the Council has been gratified at the election of its Vice-Chairman, Mr. J. T. Goodwin, M.B.E., to the high office of President of the Institute. It is felt that this election is in a large measure due to and fitly recognises the great services Mr. Goodwin has rendered the industry through his work for the Association during the past few years.

The main development during the year has been co-operation between the National Federation of Iron and Steel Manufacturers and the Association on the coke research being promoted by the Federation. In various districts Coke Research Committees have been formed, principally in Sheffield and Newcastle, with the object of determining the properties of coke associated with the best performance in the blast furnace. Realising the possibility of extending this work to cupola coke, and the desirability of making use as far as possible of the organisation being set up to deal with blast-furnace coke, arrangements were made for co-operation between the Association and the Federation. To make this effective the Association appointed representatives on the Sheffield and Newcastle Committees, and on the Fuel Economy Committee and Estimates Sub-Committee of the National Federation. The Association receives copies of the results obtained, and is making arrangements for the extension of the work in due course to cupola coke.

Finance.

Apart from the influence of the coal dispute referred to above, three circumstances have conspired to create this slightly unfavourable financial situation. During the early years of the Association, expenditure on office furniture, library material, and apparatus was not charged to revenue, arrangements being made to depre-

ciate it over a period of years. During the past three years, however, it has been realised that every year a certain measure of expenditure under these three heads is inevitable, and that such expenditure is most desirably charged to revenue. In addition to this, systematic efforts have been made to depreciate the amounts at which library, office furniture, and equipment were standing in the books. The whole of the Association's assets stand now in the balance sheet at the sum of £475, excluding £250 as the nominal value of assets taken over from the Falkirk Institute. The assets have not been valued, but would probably be represented by a figure of the order of £3,500. It is proposed to pursue this policy in future, and ultimately to reduce the book value of the assets to nil, and charge to revenue annual expenditures of a capital nature when the money is provided from income, although this is bound to have an apparently adverse effect on the accounts. Secondly, certain subscriptions owing at the end of the first five years' working had been treated by the Association and the Department as good debts, and grant had been received in respect of them. A residuum of these proved irrecoverable, and the grant received in respect of them has been deducted from that due for the year under review, this year thus bearing losses which have accumulated for two or three years past and amounting to £79. Thirdly, in the conditions laid down by the Department for the second quinquennium, grant is not obtained on subscriptions unless they are paid during the year in which they fall due, and for 1926-27 a sum of £57 has been lost to the Association through this cause. Since expenditure budgeted in advance is calculated on a basis of subscriptions being grant-earning, it is imperative that members pay subscriptions during the year for which they are demanded. The total expenditure, excluding the building charges, has been reduced considerably over that of last year, and the total subscription income has slightly decreased, but not as much as was anticipated, due to subscriptions of original members of the Falkirk Institute falling in this year to the Association's scale.

Conclusion.

It will be seen that in spite of the industrial conditions which prevailed during a large part of the year, the Association has made some progress, but is unable to show the decided improvement which was evident for each of the years 1924-25 and 1925-26. It is hoped that with the restoration of better trading conditions, the normal rate of progress will be resumed. It cannot be too strongly emphasised that the Association is essentially concerned with serving members, and that it is able to afford them tangible assistance in return for the cost of subscriptions, which is of value in enabling difficult trading conditions to be met more readily. Under these conditions it is possible to appeal with confidence to those still outside the Association to support it.

The Report is signed by Mr. H. B. Weeks, the Chairman of Council, and Mr. J. G. Pearce, its Director and Secretary.

New Officers Elected.

Major-General Sir Philip A. M. Nash (Chairman of the Metropolitan Vickers Company, Limited) was elected president of the Association for the coming year in succession to Sir John Dewrance. Mr. T. Donaldson, Mr. A. W. Steven, Mr. W. Reavell, and Mr. W. Turner McLellan were elected vice-presidents, and Sir William Bird and Mr. T. V. Miles were re-elected as vice-presidents.

The following gentlemen were elected to the Council to fill vacancies during the year, and whose election was confirmed at the meeting:—Professor D. Hanson, D.Sc., Mr. J. Marshall and Major J. S. A. Walker, whilst Mr. G. Pate, a retiring vice-president, was invited to continue as a member of Council. The following were elected members of Council:—Mr. Ambrose Firth, Mr. F. Ayton, Dr. S. F. Barclay, Mr. R. P. Bethell, Mr. E. R. Briggs, Mr. P. Pritchard, Mr. F. J. Taylor and Mr. V. C. Faulkner.

Nickel Alloys and Corrosion.

One of the lectures during the "Nickel Week"* recently held in Paris at the Conservatoire des Arts et Métiers, was delivered by M. PORTEVIN (director of lectures at the École Centrale), on the subject of "Nickel Alloys and Corrosion." The search for non-corrosive metals and alloys (he said) is one of the most important problems of modern industry. The study of the subject is particularly difficult owing to the diversity of the different corrosive agents and the number of factors which intervene. To begin with, the determination of corrosion can only be effected with some difficulty. Resistance to corrosion, in fact, is not a definite property of substances; it depends on the nature and the degree of concentration of the corrosive agent, the purity of the substance tested, as well as the purity of the reagent. In the second place, all the processes for identifying a corrosive attack are uncertain. Determination by loss of weight is falsified by the deposits which the attack may produce. The volumetric process, based on the volume of a liberated gas, is inapplicable in cases of slow attack, which are the most important in practice. The calorimetric method, which registers the quantity of heat liberated, is inoperative in the most usual cases of corrosion. The method by which the electromotive force of dissolution is measured, is falsified by the phenomenon of polarisation and by the importance of the personal equation of the experimenter. These two last data, however—the heat of reaction and the electromotive force of dissolution—lead to interesting conclusions. The heat liberated diminishes in cases where the heat of formation of the alloy attacked has been greater, and this permits of the elimination, in the search for compounds resisting corrosion, of mechanical mixtures formed of juxtaposed aggregates, and of research being directed towards definite compounds or those formed of solid solutions. Similarly, the examination of electrolytic tension shows that, except in the case of the precious metals, the simple metals are generally unstable in acid solutions. This applies also to an alloy formed of two or more crystals; hence the necessity of looking for alloys resisting corrosion among those which consist of a single constituent, in formations by solid solution or by a definite compound.

Number of Base Metals Restricted.

The problem may be further restricted if we consider that the alloy chosen must obviously be one offering the best mechanical qualities and the greatest facility in machining at the lowest possible cost. This excludes definite metallic compounds, which are nearly always fragile and hard; these compounds, therefore, should not be chosen except when it is a question of producing castings. The field of research may be still further limited by giving preferential consideration to alloys giving a solid solution within wide limits of concentration. This restriction will eliminate alloys with a low melting point, such as those of zinc, lead, tin and bismuth, as well as metals such as aluminium or magnesium, which melt at a low temperature and have but a slight tendency to give solid solutions. There remain, therefore, apart from the precious metals, only iron, nickel, chrome, cobalt and copper.

More Elements Eliminated.

Iron must evidently be left out of consideration owing to the facility with which it is attacked. Chrome is hardly used at all in the metallic state, and is used rather as an addition. Cobalt has properties nearly resembling those of nickel, but is considerably more expensive. Copper gives results inferior to nickel: it behaves badly in many cases in contact with the oxygen of the atmosphere. These successive eliminations show, therefore, the great importance assumed by nickel in the search for a substance which resists corrosion. According to the researches of MM. Cournot, K. Grotewold, and those of the American Society for Testing Materials these theoretical considerations are proved in practice. Alloys with a nickel basis behave best—with various percentages of contents—in contact with different corrosive agents, such as sulphuric, hydrochloric, nitric and acetic acids, sea water, chlorinated water, etc.

* October 16 to 27.

Efficiency of Nickel Alloys.

Nickel-iron alloys resist acetic acid, alkalis, a damp atmosphere, and, up to a certain point, nitric acid, although not so well as the nickel-iron-chrome alloy. They offer little resistance to superheated steam, and to hydrochloric and sulphuric acids. Nickel-chrome alloys have been specially studied by MM. Guillaume and Chevenard, and are very interesting; they resist moisture, alkalis, dilute acids, more particularly sulphuric acid (cementation boxes, pyrometer cases, valves, etc.). Nickel-manganese alloys resist alkalis and moist air. Nickel-copper alloys resist dilute sulphuric acid, both cold and hot; they resist high temperatures up to 800 deg. C. Monel metal must be specially mentioned; this is a natural alloy containing 67 per cent. nickel, 28 per cent. copper, and 2 to 3 per cent. iron. Nickel-copper-chrome alloys present a good resistance to chemicals with the exception of hydrochloric acid. Nickel-copper-zinc alloys, used for spoons and forks, present a good resistance to tartaric and acetic acid, but less resistance to mineral acids.

The nickel-chrome-iron alloys form a very important group, the iron-chrome alloy being much used in cutlery. They are non-oxidising as a result of thermal treatment, but they are fragile, and when reheated the carbide of iron is separated and the corrodibility is thus increased. Hence the necessity of keeping down the carbon (stainless iron), or else adding nickel to obtain a solid solution of all the elements in the gamma iron, and thus producing a malleable austenitic steel. This is the process which gives the most complete and most interesting results. Thus, if in cold 1 per cent. nitric acid we indicate the value of the loss of weight of mild steel by 1,000, the loss will be 326 with 13 per cent. of chrome (alone), 209 with 17 per cent. of chrome, and nil with nickel in certain alloys, especially in that composed of 0.25 C. 7 to 8 Ni, and 16 to 20 Cr, this alloy being weldable, malleable, non-magnetic, and offering a remarkable resistance to chemical agents, while its resistance is still further increased against SO_4, sulphates and ammonium chloride by small additions of copper and molybdenum. These austenitic steels containing nickel-chrome may have different compositions according to the reagents contemplated. For example, steel in which Ni = 6 and Cr = 17 resists sodium bisulphate better than steel with a high nickel content (Ni = 23. Cr = 10), which, however, has a much higher resistance to sulphuric acid and potassium bisulphate.

Confirmation of these results may be found in a detailed study by W. Rohn of about 40 different metals and alloys, which had been subjected to numerous reagents. These experiments showed that the alloys possessing the highest resistance are:—(1) To 10 per cent. nitric acid: Iron-chrome, iron-chrome-cobalt, and nickel-chrome-molybdenum. (2) 10 per cent. sulphuric acid: Nickel-iron, nickel-chrome-molybdenum. (3) 10 per cent. hydrochloric acid: Nickel-chrome, and more particularly, nickel-chrome-molybdenum. The types of nickel-iron-chrome alloys with 4 per cent. molybdenum in particular have a resistance in cold concentrated aqua regia comparable with gold.

To sum up, nickel and chrome steel alloys, which are malleable and specially resistant to corrosion, either alone or with small additions of molybdenum, tungsten, etc., and particularly nickel-chrome austenitic steel, are destined to play an increasingly important part in resistance to corrosive agents.

Canada's Foundry Business Improving.—Canadian foundries during the first six months of this year bought $284,604 of foundry equipment from the United States, as against $153,351 for the corresponding period of 1925. As this year Canada has harvested the second largest crop on record, it is confidently expected that these figures will be increased next year. If Britain can do any business in this direction the conditions now seem favourable for sending along live representatives.

The Chemical Constitution and Refractoriness of Moulding Sands.*

By J. G. A. Skerl, M.Sc., F.G.S.

At the beginning of the present century the only and rare criterion, except, of course, that of practical usage, used in the evaluation of a moulding sand was that of its chemical analysis. The analysis showed the percentages of the oxide of silicon (SiO_2), aluminium (Al_2O_3), iron (Fe_2O_3), and hydrogen (H_2O), and sometimes calcium (CaO), and the alkalies (Na_2O or K_2O). It was common to regard the alumina (Al_2O_3) as representing the bond or clay portion of the moulding sand, and on the percentage of this oxide the strength value of the sand would be judged. The modern tendency to place less reliance on the chemical analyses of moulding sands will be appreciated when it is realised that many siliceous materials such as gravels, bricks, slags, etc., may have analyses similar to that of a moulding sand.

The chief constituent of a moulding sand is sand or rounded grains of quartz, but other minerals are found in varying quantities. Quartz is the commonest form of silicon dioxide or silica (SiO_2); it cannot be melted at temperatures attainable in ordinary foundry practice, but is attacked by molten materials at high temperatures. Since quartz-sand grains form the structure of a moulding sand, any material in the sand which attacks the quartz will lower the refractoriness or resistance to heat of the sand. The value for the percentage of silica obtained by analysis of a sand does not represent the percentage of quartz, for other minerals contain silica as a constituent. Such minerals as clay (hydrated aluminium silicate), felspar (alkali aluminium silicate), and many other minerals found in moulding sands, contain a large percentage of silica. These other materials may be very fusible, and, therefore, lower the refractoriness of the sand to a very considerable extent.

Another error, which has been mentioned above, is the assumption that the percentage of alumina (Al_2O_3) represents the clay or bond of the moulding sand. The chemical formula for pure clay, assumed to be Al_2O_3, 2 SiO_2, 2 H_2O, shows that the amount of alumina contained therein is 39.7 per cent. The mineralogical analysis of sands shows, however, that in all sands there exists a varying proportion of felspars, all being alkaline or alkaline earth aluminium silicates and micas (hydrated aluminium silicates of various bases). The percentage of alumina in felspars will vary from 18 to 39 per cent., and in micas up to 39 per cent. In the red moulding sands of the Midland area felspar percentages of 20 per cent. or more are quite common, so that a clay or bond content estimated on the alumina content of these sands may be very erroneous.

How Felspar and Mica Act.

Felspars and micas have a fusion range much below that of quartz, the former varying from 1,100 to 1,500 deg. C., and the latter 1,240 to 1,370 deg. C., temperatures below that of teeming steel and of some grey irons. This is sufficient to explain why the Bunter red sands are useless in the steel foundry, and why some sands otherwise suitable cause increased work in the fettling shops of the grey iron foundry owing to the molten felspar attacking the quartz of the sand, and also the iron, causing "burning on," etc.

Iron oxide is usually assumed to be present in the hydrated form of ferric oxide, Fe_2O_3, x H_2O, of variable composition. This is generally the case, and the exceptions are the scales and lumps of hematite found in some red sands, in the micas and in glauconite (a hydrated potassium iron silicate), which is found in the more recent (geologically) sand-producing horizons such as Erith and Southampton and the glacial sands of the north-east and east of England. The percentage of iron oxide in a moulding sand cannot be judged from the colour of the sand. The pale sands of Erith, the red Bunter sands of the Midlands and Belfast, the yellow steel-moulding sands of Cornwall and Yorkshire, all contain similar total percentages of iron oxide—that is, about 3 per cent.

The largest proportion of the iron oxide is to be found in the bond or clay grade of a moulding sand, showing that oxide is finely divided and is probably colloidal. The hydrated iron oxides, unlike clay, the major bonding material, possess the property of being rehydrated after they have been dehydrated by the heat of the molten metal. This is a valuable property, as it increases the life of the sand. Ferric oxide has a high fusion point, but when attacked by other molten materials under reducing conditions forms complex ferrous silicates with low melting points. Ferrous oxide in a moulding sand is, therefore, a detrimental constituent. Fortunately, this oxide does not exist in the free state in moulding sands, but only in combination with other oxides, as in glauconite, etc.

Lime Not Always Deleterious.

The percentage of lime in a moulding sand is usually not more than 0.5 per cent. It has been customary to regard this oxide definitely as a harmful constituent, assuming on account of its alkaline characteristics that it will form exceedingly low melting-point silicates on contact with molten metal. The extensive and successful use of moulding sands with 2 per cent. or more lime (CaO) both in this country (Durham, Heck, Mansfield) and America (Illinois) shows that this assumption is not altogether correct, and that the form in which it occurs must be a deciding factor. Lime occurs generally as felspar (CaO, Al_2O_3, 2 SiO_2), calcite ($CaCO_3$), or dolomite ($CaMg(CO_3)_2$). Lime felspar, usually containing a percentage of sodium felspar, is easily fused by molten cast iron, and it is undoubtedly sands containing lime in this form and in considerable quantities which are troublesome to the iron founder. On the other hand, calcite and dolomite, although decomposed at about 800 deg. C., form highly infusible oxides, which, unless attacked by other molten material, will render the sand more refractory.

Magnesium oxide is found combined in moulding sands in several forms, but usually as dolomite (considered above), and in micaceous minerals. The percentage of magnesia is always high in the clay portion of a sand, due chiefly to the presence of the micas. These, however, are easily fusible minerals, and lower the refractoriness of the bond considerably.

Alkalies Have Adverse Influence.

The alkalies occur chiefly in the felspars and micas, and also as adsorbed salts in the bond. In every case the compound is readily fusible at low temperatures, forming fluxes, which attack even the most refractory material, the quartz sand grains. The alkalies are the most undesirable constituents of a moulding sand.

Other Constituents.

Little need or can be said of the other constituents of the sand. Titanium oxides occur in the form of rutile crystals which develop in the clay grade. They are very infusible. Manganese oxide is common in the red sands of the Midland area, occurring in black grains. The percentage is usually small, about 0.1 per cent., and its power for good or evil has not been sufficiently manifested. The small amounts of chlorides, sulphates, phosphates, etc., which occur are usually present as the acid radicals of alkali or alkaline earth salts, and therefore have a detrimental effect. Carbon dioxide, the presence of which is denoted by adding a little warm dilute hydrochloric acid to the sand, denotes the presence of carbonates, the chief of which, calcite and dolomite, have been discussed above.

Mineralogically a moulding sand should consist of quartz, clay, and hydrated iron oxide. Chemically this is equivalent to specifying that it should contain only silica, alumina, and iron oxide together with combined water, and that these should be so constituted as to form the minerals mentioned. Unless the chemical oxides be arranged to form the mineralogical compounds given, the material will not be a moulding sand. The question may be asked whether chemical analyses are of any value in the evaluation of a moulding sand. The answer must be, certainly, but only if interpreted correctly. The alkalies, calcium, and magnesium must be low, and the alumina and iron oxide contents, together with the silica and loss on ignition (water of constitution) should total more than 92 per cent. in a grey iron moulding sand, and over 95 per cent. in a sand useful for steel casting.

Factors Other Than Composition.

Something has been said on the refractoriness of the sand in the preceding paragraphs dealing with the chemical composition, but some factors of the greatest importance have not been mentioned. They are the size factor, the time factor, and the load factor. Considering the size factor first, it is much easier to melt small particles than large ones—*e.g.*, four quarter-pigs than one whole one, under identical conditions, for the absorption of heat, and, therefore, rate of melting is dependent on surface area. The larger the surface the more rapid the absorption of heat and fusion of the material. Hence the bond or clay grade of moulding sand being the finest material must be as refractory as possible; in practice the clay is the grade-size which is most readily fused owing to the fact that colloidal material absorbs salts from the liquid in which it is formed or deposited. The salts, although small in amount, are usually alkaline compounds with low melting points.

Pressure Lowers M.P.

The longer the sand is exposed to a high temperature the greater the need for refractoriness. This time of exposure is largely governed by the section of metal, and it is obvious that a sand needs higher refractoriness to withstand the longer period of heat emanation arising from a thick section of molten metal than from a more rapidly cooling thin section.

The foundry making large castings, for example, of anvil blocks, large ingot moulds, etc., finds that the portion of the casting which is at the bottom of the pit invariably requires more fettling than elsewhere, if the same sand is used throughout the mould. This is because the pressure exerted by the many tons of metal is sufficient to lower the fusion point of sands by considerable amounts, often over 50 deg. C., which in the case of many sands is sufficient to fuse most of the finer-grained material, so that it runs between the sand grains, attacking them, and also the surface of the castings, causing "burning-on," etc. Thus if two sands, identical in mineralogical and chemical constitution, but one with a coarser grading than the other, be used to form similar moulds into which metal from the same ladle be poured, the finer-grained material will fuse more readily than the coarser, and eventually cause a larger amount of fettling. Therefore, for large castings, or where the metal will have a thick section, a coarse sand is to be preferred.

To sum up, in grey iron foundry practice, at any rate in the production of small or medium castings, the question of refractoriness of a sand is never of vital importance, for wasters due to lack of this property are not common. But where thick sections, heavy castings, or the use of very hot metal is necessary, trouble is often experienced in "burning-on." The large amount of heat to be dissipated through a material of low thermal conductivity such as sand will give the time-temperature relationship necessary for the fusion of the sand. If this fusion is only incipient—that is to say, a thin slag layer is formed at the surface of the mould—the skin of the casting will be good. Indeed, many founders, especially in the steel foundry, promote this surface slagging by means of paints, etc., holding the view that a better stripping and surface is thereby attained. On the other hand, if the slag is such that it attacks the coarser grains of sand, it will eventually break the mould surface, whether it be "blacked" or not, and unite with the metal. The answer to the question of the sand's refractoriness and suitability for the job will then be found in the fettling shop.

* B. C. I. R. A. Bulletin.

Foundry Purchasing—XVII.

By Eric N. Simons.

It is essential that report and test files should be kept up to date, and that steps should be taken to ensure the collection of all the requisite data in regard to the performance of goods. In far too many works the buyer, having had delivered the ordered supplies into the stores, or having sent them direct to the consumers, loses all sight of them henceforward, and can only assume that they have been satisfactory when no direct complaints are made. In the first few articles of this series a means of obtaining regularly the personal opinions of departmental managers on the goods supplied to them is outlined, but this may not always be feasible. Some other plan must, therefore, be adopted, but whatever it may be, the departments themselves must co-operate. They must, wherever they can, keep accurate and informative records of performance. How seldom this is done is well known in foundry circles. Yet in the comparison of commodities it is performance that counts. Tests, physical or mechanical, are not absolute indications of what a product will do in practice. They are merely guides, safeguards.

Of course, it is by no means easy or even possible to keep full records of the performance of every commodity bought or used. A file, for instance, may be used one day on difficult work, another day on easy work. It would be almost impossible to say that because one file lasted six months against another make of file's seven months, the second was the better. It would all depend on how, on what, and by whom they had been used, and the conditions would be found to fluctuate so much that comparisons of an effective kind would be impossible. But at the same time, it is possible to average out performances over a sufficiently long period, even for goods that do not lend themselves to direct comparison.

Performance Details Essential.

The importance of maintaining records of performance—full, wherever possible; average, where not—is that they enable the buyer (and, incidentally, the department concerned) to give different makes of goods a trial that shall be both fair and informative. If the buyer has no records he cannot form a sound judgment of the merits of a new brand. He will have to take the word of this person or that that the new material is better than, or worse than, or as good as the old. And those who know the ways and temperaments of men asked to try out products different from those to which they are accustomed know how seldom they admit any improvement. Human beings in the mass are conservative, and unless men are on piecework, where anything that increases their actual output brings them direct pecuniary benefit, they will seldom report favourably on goods given to them to try out. Certain products have to be handed over to a department with instructions to "try them out and let me know what you think about them," simply because they do not lend themselves to detailed comparisons. Cutting compound, for example, is judged not by the amount of work it lubricates over a given period, but by its general efficiency in rendering cutting operations easier and more effective. On such a subject, only the operator's opinion can be taken as a basis. But there are far more commodities than is generally imagined whose performance is capable of accurate measurement, and the existence of information concerning the materials actually being used enables a proper comparison to be made between these latter and the products being tried out.

Checking Variable Quality of Supplies.

An important point is that records of performance should not be intermittent, which recommendation applies equally to records of analysis and test. It must be remembered that not every supplier is consistent in his production, and therefore there is always the possibility that goods, originally satisfactory when measured by actual performance, may have fallen off in quality, with the result that they no longer do what the user believes them to be doing. A fact of this kind can only be discovered by the continuous keeping of accurate records. It is highly desirable that uniformity of materials should be maintained, since otherwise the buyer is paying over a definite or indefinite period—according to the frequency with which he measures performance—an unvarying price for goods that do not always do the work that the price represents. This is a source of loss, all the more dangerous because not readily detected.

Furthermore, these records enable either buyer or departmental manager, or both, to discover careless usage by actual consumers of the products concerned, and to effect considerable savings in wasted material, either by replacing the operators with more competent men, or by giving them the requisite training in the handling of the goods. For example, in one works the buying records showed that circular saws were doing far less work than formerly, though the source was unchanged. Saws returned to the maker, with a complaint of this falling off in performance, brought an expert by return. The latter demonstrated that the impaired performance was entirely due to the saws being used on the wrong kind of work, work for which they had never been designed. This revealed incompetency in the foreman of the sawing department, and when he was replaced by a better man, the saws at once began to turn out their old amount of work. Instances of this sort could be multiplied.

Catalogue Files.

An indispensable part of the statistical and data-collecting side of a foundry buying department's work is the establishment and maintenance of a catalogue and handbook file, in which are kept the various pieces of printed matter issued by suppliers in respect of their goods. It has to be confessed that in this file there will inevitably be a lot of "dead wood," or matter that, owing to the inefficiency with which it has been compiled, is almost useless as a guide to the purchase of the products it concerns. But although manufacturers and suppliers have undoubtedly much to learn in regard to the needs of a buyer, so far as informative literature goes, the percentage of those who either attach sufficient importance to their printed matter to prepare it thoroughly from a selling point of view, or, knowing their own capacities in this direction, put its preparation in the hands of a competent advertising agency, is growing larger every year.

There are three kinds of printed matter issued by suppliers. In the first place, there is the catalogue proper, which—if designed expertly—gives not only a comprehensive summary of everything the manufacturer supplies, but also every item of information likely to be of service to the buyer in making effective comparisons. For example, notes on how to order certain specialised commodities, on how to save money by ordering in bulk or in ton lots; reports of actual performances; details of important constructional principles and composition; all increase the reference value of the catalogue, and make it a valuable addition to the library. Catalogues of this sort should never be carelessly thrown away. There is always some occasion when a special commodity is needed and catalogues have to be ransacked to find it. The information in a well-designed catalogue file will, at such times, prove of real use in ordering, or even in sending out inquiries. If wrong particulars of requirements, or insufficient details, are sent, the result is bound to be delay in quoting or execution. The value of the filed catalogue is that consultation of its contents often saves money and prevents delays and mistakes.

The second class of literature includes price lists and discount sheets. These, if unaccompanied by descriptive or explanatory matter, are not of great importance. They are constantly running out of date, and, in any event, are useful only for the purpose of comparing prices and quotations, and checking invoices, or for making out orders. This does not mean that prices should be omitted from suppliers' literature, but only that if the space available for filing is limited, it is better to preserve good catalogues than mere price lists.

Misusing Technical Handbooks.

The third class comprises the technical handbooks or instruction leaflets intended primarily for the actual user of the goods. For example, the manufacturer of a jarring machine might issue a booklet carefully explaining the mechanism of the machine and the method of operation. The great mistake made by many buying departments is that they write for or obtain the instruction leaflets or booklets, and instead of passing them on to the works, file them in the catalogue library. The result is that the man who ought to have all the information possible that will enable him to get better work from the goods is left to his own devices, to learn their peculiarities by the costly method of trial and error. Valuable technical matter is buried in the catalogue file, because it is unlikely that the buyer or his assistants will ever have the same need for it as the man in the works. It should be a rule that every technical handbook or instruction sheet should go into the works to the men who need it. If, as sometimes happens, this information is bound up in the same covers as material of value to the buyer himself, or the buyer desires to have it by him for his own reference and use, it is best to write for duplicate copies, sending one into the works, and filing the other in the library.

Cohesion.

The introductory Paper at a Conference held on November 23 by the Faraday Society on the subject of "Cohesion" was read by the President (PROFESSOR C. H. DESCH, D.Sc., F.R.S.). According to this the phenomena of interest to the engineer and metallurgist, depending on the nature of cohesion, may be summed up as follows:—

(1) The tenacity of metals, of crystals such as rock salt, and also of glassy substances, as determined by a tensile test, is very much less than that calculated from physical theory.

(2) The so-called elastic limit is not a physical constant. The more delicate the extensometer used, the lower is the stress at which permanent deformation is seen to begin. Single crystals appear to yield at the lowest stress which can be applied in a testing machine.

(3) Failure by fatigue, that is, by repeated applications of stress, occurs under much lower ranges of stress than that required to produce failure under static loading.

(4) The process of cold-working, or of deforming a solid at a temperature below some limiting temperature (usually about one-third of the absolute temperature of melting) alters the properties of the material to a remarkable extent.

(5) The manner of deformation depends to a great extent on the rate of application of the stress, and the time during which it is applied.

(6) In bodies composed of many crystals, there is a marked difference between the properties of the interior of crystals and their boundaries which is imperfectly understood, and this difference is of importance in relation to many facts of strength and fatigue.

(7) The nature of crystal surfaces is of importance in the study of lubrication, where solid surfaces are separated by a thin liquid film, and in that of welding and sintering, in which surfaces are united by contact at temperatures below the melting-point.

(8) Closely connected with this last point is the problem of adhesives and solders, or materials, thin films of which can unite firmly solid masses, and that of the adhesion of coatings of foreign material deposited by electrolysis or other processes.

(9) Diffusion can occur in solids, and is of importance in many technical processes. It is not certain whether it takes place by change of place of atoms in an undisturbed lattice, or whether previous loosening of the lattice is essential.

Trade Talk.

The Lilleshall Company, Limited, have damped down their furnaces near Shifnal, Salop.

Alfred Holt & Company, Fenwick Chambers, Fenwick Street, Liverpool, have removed to 9, Rumford Street, Liverpool.

Ataka & Company, Limited (Rep. K. Tachikawa), 3, Newman's Court, Cornhill, E.C.3, have removed to 59, Mark Lane, London, E.C.3.

Whilst dismantling operations were in progress at the Birchills Furnaces, Upper Green Lane, Walsall, a disused blast furnace collapsed, killing two men.

An American export firm has secured from the Turkish Government orders involving an expenditure of £450.000 for the construction of car and locomotive repair shops at Kaiserieh (Cesarea).

A meeting of the Institution of Welding Engineers was held at Cardiff last week, when Mr. W. H. Walby read a Paper entitled "The Welding of Cast Iron and Aluminium by Oxy-Acetylene Process."

The Department of Overseas Trade has received from the British Legation at Bogota, translation of the general conditions which will govern future public calls for tender invited by the Commercial Section of the Ministry of Public Works of Colombia.

The Railway Administration of the Union of South Africa has placed an order for 200 steel bogie wagon underframes worth £60,000 with the Belgian company Forges, Fonderies et Usines de Haine-St. Pierre in competition with British, American, and other firms.

The Yokohama Corporation has placed a contract for rails for a line 23 km. (about 14 miles long) with the Luxemburg selling organisation Columeta, whose tender was lower than the offers received from German, British and American works. The price has not been published.

Sir Hugo Hirst, Bt., chairman of the General Electric Company, Limited, has been elected to succeed Sir Richard Gregory as president of the Decimal Association. The annual meeting of this Association will be held on December 6 at 5.30 at the Institution of Electrical Engineers.

The machinery and plant of the Hook Shipyard, a war-time industry at Goole, and which was established by the Ouse Shipbuilding and Repairing Company, Limited, has been sold to Thos. W. Ward, Limited, of Sheffield, and the works are to be dismantled at an early date. The yard ceased operations five years ago, and no use has been made of the plant since.

The Standing Committee (General Merchandise) appointed by the Board of Trade will hold their inquiries as to whether electric cables and wires insulated, of all descriptions, should bear an indication of origin, on Monday and Tuesday, December 12 and 13. The inquiries will be held at the New Public Offices, Great George Street, London, S.W.1, the secretary being Mr. E. W. Reardon.

As announced in Parliament, the Glasgow firm of Sir William Arrol & Company, Limited, have secured the contract for a bridge over the River Benue, in Nigeria. The estimated cost is £960.594, and the whole work will be constructed in Glasgow and shipped to Nigeria. The bridge is to be a combined railway and road bridge half a mile long. There will be thirteen spans. Ten of them will be 186 ft. long and three of them 246 ft. long.

Company Meeting.

Brown, Bayley's Steelworks, Limited.—The ninth annual meeting of shareholders was held at Sheffield on November 24. Mr. Robert Armitage, the chairman and managing director, presided, and, moving the adoption of the report, mentioned that during the first four months the company's business was affected by the coal strike. They had been able to pay another whole year's dividend on the preference shares. He did not propose to make any comments on the law case they had lost. The Farnley Iron Company, in which they had a large interest, had been trying to sell a good deal of their property, and negotiations were proceeding with possible buyers. Some of the property was to be put up for auction in January or February. Lord Ernest Hamilton seconded the report, which was adopted.

Liège International Exhibition, 1930.—In connection with the celebrations of the Centenary of the Independence of Belgium, an international exhibition of heavy industries, etc., is to be held at Liège in 1930. Copies of the official programme can be obtained from the offices, 4, Place Saint-Lambert, Liège.

Personal.

Mr. Brian Ashcroft and Mr. Thomas Barlow have been elected additional directors of the Canning Tinplate and Iron Company, Limited.

Mr. Evan Davies, who has resigned the position of mill manager at the Panteg Steelworks of Baldwins, Limited, after having held it for fourteen years, was on Saturday week the recipient of a presentation from the workmen.

Mr. Percy Pritchard, managing director of the Midland Motor Cylinder Company, Limited, has been elected managing director of the Birmingham Aluminium Casting (1903) Company, Limited, in place of the late Mr. F. W. Gower.

Wills.

Evan-Thomas, E. L., of Eastbourne, formerly a director of Baldwins, Ltd.... £48,828

Morrison, J., of Caplethill Road, Potter Hill, Paisley, coppersmith, brass-founder and engineer £8,712

Smith, R. H., of Stanley Terrace, Swansea, manager of Vivian & Sons, now British Copper Manufacturers £4,118

Wright, T., of Victoria Road, Whitehaven, engineer and machinery merchant of T. Wright & Company £5,915

Hurst, W., of Rock Cottage, Castle Road, Newport, Isle of Wight, head of W. Hurst & Son, ironfounders, etc. £4,097

Broadbent, J., of Stalybridge, Cheshire, director of R. Broadbent & Sons, Limited, the Phœnix Iron Works £13,202

Keatley, J., of Woodcroft, Blackwell, Worcs., managing director of James Keatley, Limited, brass casters, Birmingham £8,097

Price, J., of Roseberry, Spring Hill, Halesowen, and of J. Price & Sons, Limited, manufacturers of nails and spikes, Halesowen £15,391

Jones, A. A., of Brooksby, Uppingham Road, Leicester, of A. A. Jones & Shipman, Limited, machine-tool manufacturers £105,593

Lindop, R. C., of Sunnyside, Grove Road, Fenton, Stoke-on-Trent, managing director of the Manor Engineering Company, Limited £7,190

Duff, Mr. Peter (76), of Braco, Park Road, West Kirby, Cheshire, late chairman and managing director of Messrs J. Gordon Alison & Company, Limited, engineers and ship repairers, of Birkenhead (net personalty £78,299) £82,933

Patchett, Lieut.-Col. J., of Haybridge Hall, Wellington, Salop, chairman and managing director of the Shropshire Iron Company, Limited, and a director of the Union Steel Corporation of South Africa, Limited, and of J. C. Hill & Company, Limited £72,086

Davies, Sir John Cecil, vice-chairman and managing director of Baldwins, Limited, managing director of the Port Talbot Steel Company, Limited, chairman of the Beaufort Works, Limited, of the British Mannesmann Tube Company, Limited, of the Oxfordshire Ironstone Company, Limited, and of the Ystalyfera Tinplate Company, Limited £92,072

New Companies.

S. E. Dawson & Company, Limited.—Capital £10,000. Steel, iron and brass founders, etc. Directors, S. E. Dawson, C. Y. Burton and W. Wellens. Secretary, S. E. Dawson, 8, Lynton Park Road, Cheadle Hulme, Cheshire.

Engineering and Commercial Institute of Great Britain, Limited, Thanet House, 231-2, Strand, W.C.—Capital £1,500 in 2s. shares.

C. H. Garstin & Company, Limited, Portland House, 73, Basinghall Street, E.C.—Capital £250. Dealers in iron, etc.

League of Nations Bulletin.—We have received from the London office of the League of Nations a copy of the October issue of their Monthly Bulletin of Statistics containing numerous tables, among them some showing the output of coal, lignite, pig-iron, and ingot steel of various countries. The text is in French and English throughout. The agents for the publications of the League are Messrs. Constable & Company, Limited, 10-12, Orange Street, London, W.C.2.

Contracts Open.

Bogota, January 15.—(12) Air compressors, for the Colombian Ministry of Public Works. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 5,505.)

Buxton, December 10.—(6) Castings (street ironwork), for 12 months ending December 31, 1928, for the Town Council. Mr. F. Langley, borough engineer, Town Hall, Buxton.

Dundee, December 10.—Iron and steel for six or 12 months, for the Dundee Harbour Trustees. Mr. J. H. Thompson, general manager and engineer, Dundee.

Easingwold, Yorks., December 12.—Cast-iron tank, 11,650 yards of 5-in., 3,000 yards of 4-in. spun iron water mains, and 3,400 yards of 3-in. cast-iron water mains, also valves, washouts, fire hydrants, consumers' services, pillar fountains, etc., for the Easingwold Rural District Council. Messrs. Fairbank & Son, the engineers, Tudor House, Stonegate, York. (Fee £3 3s., returnable.)

Johannesburg, January 5.—Axles, wheels and axles, wheel centres and tyres, for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 5,539.)

London, S.W.1, December 13-15.—(1) 204 tons of structural steelwork for engine shed; and (2) nine petrol tank wagons, four-wheeled, I.R.C.A. standard type, K1, complete with wheels and axles (broad gauge), for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fee £1, non-returnable.) Tenders due December 15 for (1) and December 13 for (2).

Melbourne, January 11. — One impact testing machine, for the Victorian Government Railways Commissioners. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 5,535.)

Ripon, December 14.—1,276 yards of 4-in. cast-iron or spun-iron pipes, 2,000 yards of 3-in. cast-iron pipes, together with the construction of a covered service reservoir, windmill, engine-house, oil engine, hydrants, valves, etc., for the Rural District Council. Mr. F. S. Gowland, clerk, 5, Finkle Street, Ripon.

Stockton-on-Tees, December 10.—(1) Gas meters; (4) lead pipe and compo pipe; (5) wrought-iron tubing, I.G.E. special; (8) bolts, nuts and rivets; (9) castings; and (11) gas mains and special pipes, for six months ending June 30, 1928, for the Corporation. The Engineer and General Manager, Corporation Gasworks, Thompson Street, Stockton-on-Tees.

Company Reports.

Power Gas Corporation, Limited.—Dividend, 5 per cent., less tax, for year.

Whitehead Iron & Steel Company, Limited.—Interim dividend, 4 per cent. (actual), less tax.

J. & E. Hall, Limited.—Net profit, £38,048; dividend for year on ordinary shares, 7½ per cent.; transfer from reserve fund, £10,000; carry forward, £6,941; brought in, £9,893.

Birmingham Aluminium Casting (1903) Company, Limited.—Net profit, £15,565; brought in, £25,228; dividend, 7 per cent. upon ordinary shares, less tax; carry forward, £29,593.

Cargo Fleet Iron Company, Limited.—Brought forward, £178,608; profits, £88,354; debenture interest, £38,743; depreciation, £50,000; balance, £178,219 carried forward.

South Durham Steel & Iron Company, Limited.—Profit, after transferring from special reserve account £52,664, £97,044; brought forward, £139,596; total, £236,641; interest on debenture stock, £13,500; dividend on 6 per cent. cumulative preference shares, to June 30, 1927, £13,500; depreciation, £50,000; balance, £159,641; dividend, 1s. per share, 1927, on ordinary shares, £17,500; provision for dividend on 6 per cent. cumulative preference shares, to September 30, 1927, £4,500; carried forward, £137,641.

Shotts Iron Company, Limited.—Profit, £126,392; balance, £21,396; reserve, £30,000; depreciation, £48,574; interim dividend on preference shares, £2,313; interim dividend on second preference shares, £447; dividend on preference shares for second half-year, 2½ per cent., less tax, making 5 per cent. for year, £2,313; dividend on second preference shares for second half of year, 2½ per cent., less tax, making 5 per cent. for year, £447; dividend on ordinary shares for year, 5 per cent., less tax, £20,845; carry forward, £42,847.

"Pyrolyte" is a Fine Powder in a Water- & Air-tight Drum

"PYROLYTE" WILL KEEP FOR EVER IF THE LID IS RE-PLACED

"PYROLYTE" is an ideal handy Patching for any Kiln or Furnace crack or worn place

A graphic illustration of the wonderful strength of a joint made cold from

"PYROLYTE"

The unique Cold Setting, Heat Resisting Fire Cement.

Sample cwt. drum - **30/-** nett, carriage paid. Drum free.

For all Furnaces Kilns & Ovens

Our photograph is a convincing demonstration of the "green" strength of "Pyrolyte" joints.

The picture shows two firebricks cemented end to end with "Pyrolyte" allowed to set cold.

The joint is here seen supporting a 10-stone man, but it would have supported three others also without breaking!

We have the identical bricks in our office, and will show you the test at our Kelham Island works!

Telephone— 22311 Sheffield. (3 lines)

For all Firebrick Constructions

"Pyrolyte" does not merely give "green" strength

Its GRIP is not weakened by any commercial heat, for "Pyrolyte" is so refractory and infusible that it will often outlast the bricks themselves.

The joint is, moreover, highly resistant to corrosion by slag or ash of any kind.

A firebrick wall set in "Pyrolyte" is truly MONOLITHIC, and if the exposed face is "washed" with a thin coating of the cement its life is thereby prolonged to a remarkable extent.

Telegrams— "Refractory" Sheffield.

THE GENERAL REFRACTORIES Co. Ltd.

SHEFFIELD.

Sole Makers of this remarkable Cement that STICKS LIKE GLUE and CANNOT BE MELTED by any commercial heat.

"Pyrolyte" is peculiarly valuable for use with Magnesite and Chrome bricks.

A wash of "Pyrolyte" is an astonishing preservative of an Electric Furnace roof.

"PYROLYTE" acts like an Infusible Portland Cement

Iron and Steel Markets.

Pig-iron.

MIDDLESBROUGH.—Almost unexpected during the closing weeks of the year, a striking development of the Cleveland iron market has just been disclosed in the announcement of the Ironmasters' Association to revert to a flat rate for foundry and forge iron, irrespective of destination, and their decision to eliminate the merchants from participation in the Scottish trade. The restoration of the flat rate is in effect a reduction of 2s. 6d. per ton to the home consumer. It is a concession which has been reluctantly made, but circumstances have been too powerful for the ironmasters to resist any longer the persistent bear pressures. This concession will unquestionably have far-reaching results on the iron trade in general, and has already had a stimulating effect upon buying by home consumers, some good orders having been booked from English works, but the Scottish and export trade is still quiet, and will, it is feared, remain so as long as foreign iron is on offer in Scotland and in neutral markets at prices so much lower than Cleveland. Prices having now become stabilised at universal rates, and irrespective of destination, No. 1 Cleveland iron is quoted 67s. 6d. per ton, No. 3 G.M.B. 65s., No. 4 foundry 64s., and No. 4 forge 63s. 6d. per ton.

Transactions in East Coast hematite continue on a limited scale, furnace stocks are heavy, and the prospect of a curtailment of output is by no means remote. Nominally prices are unchanged, with mixed numbers at 71s. 6d. per ton, and No. 1 quality at 72s.; but these prices are only realisable for very small lots and reductions are obtainable on bigger parcels. On the North-West Coast prices are again on the easy side, Bessemer mixed numbers being offered round 72s. per ton, f.o.t. works.

LANCASHIRE.—Local consumers of foundry pig are still limiting purchases within narrow compass, with few changes of importance in current quotations. For delivery in Lancashire, Cleveland No. 3 is now quoted at round 78s. per ton, whilst for delivery Manchester or equal Derbyshire makes are on offer at from 73s. 6d. to 74s. per ton, according to quantity, Staffordshire at from 73s. to 73s. 9d., and Scottish at round 88s., although in the case of the last-named, certain special varieties are quoted at up to 95s.

THE MIDLANDS.—Little improvement in conditions of the market for pig-iron is now expected during the current year, and quotations remain about the same as previously noted. There have been very few offers of any size to show to what limits the iron-founders would go, but Derbyshire No. 3 can be obtained at 65s. f.o.t., and Northamptonshire at 60s. per ton. A few of the makers can get 6d. or 1s. above these levels.

SCOTLAND.—The decision of the Cleveland ironmasters as regards merchants' sales in Scotland, as above outlined, has been severely criticised in local market circles, while buyers also feel not too pleased at having to cease dealing with firms with whom they have had pleasant relations for many years. Business in pig-iron is still very slack, and the price of No. 3 Scotch foundry is unchanged at 72s. at furnaces, but makers report that if they were prepared to take 70s., they could probably sell some large lots.

Finished Iron.

Demand for finished material of most descriptions continues on the quiet side, many of the mills and forges in the Staffordshire districts having only sufficient orders for part-time working; these conditions are expected to last over the rest of the year. Keen competition is also in evidence in the home market for any business brought forward, with the result that prices for South Staffordshire crown iron vary considerably, and any figure from £9 7s. 6d. to £10 5s. is quoted for this grade. Nut and bolt iron is offered at £9 delivered Darlaston area, but little business is possible on account of the Continental competition. The Belgian product is a little firmer in price, and the present quotations are £5 17s. 6d. to £6 delivered. There is no alteration in the price of Staffordshire marked bars, which is £13 at makers' works. The makers of this class of iron do not have to contend with much Continental competition, and they are fairly well engaged at the moment.

Steel.

As usually expected towards the end of the year, the markets for steel and semi-products have considerably slowed down, and few new orders are now in circulation. At Sheffield, basic billets are quiet, but acid qualities keep up fairly well. The quotation for Siemens' acid billets is maintained at £10 per ton delivered, and basic billet quotations are:—Soft, £6 10s.; semi-hard, £7 10s.; medium, £7 12s. 6d.; hard, £8 2s. 6d. There is a fair demand for steel hoops at £9 10s. and £10 per ton delivered. There have been no further changes in the values of Continental semis, and the figures previously quoted still obtain. The manufacturers, however, are not disposed just at the moment to make concessions. The current quotation for soft Thomas billets is round about £5 5s., blooms £5, and sheet bars £5 6s. 6d. to £5 7s. 6d. per ton, all delivered works in the Midland area.

Scrap.

Although there has been little change for the better in most of the scrap metal markets, foundries on the North-East Coast are using more heavy cast iron, and the recent advance in price has been well maintained. good machinery quality in handy pieces realising 66s., and ordinary quality 62s. 6d. per ton, delivered works. In the Midlands there is still a good demand amongst the local foundries for cast-iron material, and for the better qualities of machinery cast-iron scrap, in cupola sizes, 72s. 6d. per ton delivered is still being obtained. The light cast-iron scrap is, however, weak at 55s. per ton delivered. In South Wales heavy cast-iron scrap in large pieces and furnace sizes remains slow at 58s. to 60s. Good cast-iron machinery scrap in cupola sizes has a slow local demand at about 62s. 6d.

Metals.

Copper.—Following an earlier slight set-back, standard copper at the week's closing market for the first time this year advanced above the £60 level. This improvement was due to the issue of the figures of the United Kingdom stocks, which during November fell 1,314 tons for refined to 633 tons, and 1,260 tons for rough to 12,176 tons. There has also been more activity in manufactured copper in the home trade, and higher prices are quoted on export business, particularly for copper squares and yellow metal sheets.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £59 11s. 3d. to £59 12s. 6d.; Friday, £60 5s. to £60 6s. 3d.; Monday, £60 7s. 6d. to £60 8s. 9d.; Tuesday, £60 7s. 6d. to £60 8s. 9d.; Wednesday, £60 13s. 9d. to £60 15s.

Three Months: Thursday, £59 16s. 3d. to £59 17s. 6d.; Friday, £60 8s. 9d. to £60 10s.; Monday, £60 12s. 6d. to £60 13s. 9d.; Tuesday, £60 10s. to £60 11s. 3d.; Wednesday, £60 16s. 3d. to £60 17s. 6d.

Tin.—In this section also business has developed a stronger tendency, demand being more active and values advancing almost daily. This improvement may be mainly traced to a more confident sentiment and renewed speculative support induced by quite a large American demand. Purchases on Continental account were of a consistent character, and better buying was noted by Welsh consumers.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £268 10s. to £268 12s. 6d.; Friday, £267 17s. 6d. to £268; Monday, £269 to £269 5s.; Tuesday, £259 15s. to £270; Wednesday, £271 to £271 5s.

Three Months: Thursday, £265 5s. to £265 7s. 6d.; Friday, £265 to £265 5s.; Monday, £265 7s. 6d. to £265 12s. 6d.; Tuesday, £265 10s. to £265 15s.; Wednesday, £265 7s. 6d. to £265 12s. 6d.

Spelter.—Dealings in ordinary spelter of late have indicated a steady tendency, with an inclination to firmness. The greater strength has naturally attracted a little buying, while at the same time there has been rather more inquiry on the part of consumers; sellers, however, have very freely met the demand, and better conditions have, in consequence, prevailed.

The following are the week's prices:—

Ordinary: Thursday, £26 7s. 6d.; Friday, £26 10s.; Monday, £27; Tuesday, £26 15s.; Wednesday, £26 11s. 3d.

Lead.—During the past week values of soft foreign pig have also improved on those current for some time, having appreciated over 6s. per ton on the levels of the past fortnight. At the moment trading has expanded on a further advance, in spite of the fact that importers closely identified with Australian and Spanish producers have been rather free sellers. The main reason for the improvement has been the increased demand from home consumers and renewed interest on Continental account.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £22 2s. 6d.; Friday, £22 17s. 6d.; Monday, £23; Tuesday, £22 11s. 3d.; Wednesday, £22 2s. 6d.

Patent Specifications.

The following list of Patent Specifications Accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

22,346. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Electric furnaces. September 10, 1925. 258,276.

709. BROWNE, V. B. Method of producing high-grade silicon iron. January 10, 1927. 277,537.

16,972. MORTON, L., and HARGROVE, J. Furnaces having suspended arches. July 7, 1926. (Patent of Addition not granted.) 277,768.

29,846. LIERS, F. Moulds of the reversible type for casting metals. November 25, 1925. 262,121.

1,738. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Furnace regulation. January 20, 1926. 264,852.

10,020. BOHLER, E. Vertical heating furnace for rolled half-products (blooms and billets) or similar metal pieces. April 12, 1926. (Addition to 195,082.) 269,541.

13,962. SOC. D'ELECTRICITÉ DE LA REGION DE VALENCIENNESANZIN. Pulverised-coal furnaces. March 26, 1927. 277,910.

11,337. PARSONS, SIR C. A., and DUNCAN, H. M. Casting of ingots. April 29, 1926. 278,032.

16,246. MATHESIUS, W., and MATHESIUS, H. Process for manufacturing steel in open-hearth furnaces. (September 22, 1925.) 258,835.

16,266. LONGENECKER, L. S. Refractory blocks particularly for use in metallurgical furnaces. June 28, 1926. 278,070.

16,426. GIBBONS BROS., LIMITED, and COOK, N. G. Machines for discharging and charging furnaces or retorts. June 30, 1926. 278,081.

Catalogues Received.

Ladles.—Messrs. John A. Smeeton, Limited, of 15, Victoria Street, London, S.W.1, have sent us an advance copy of their four-page pamphlet dealing with the Collin type of ladle. It will be remembered that this ladle carries an air-cooled belt permitting of the tilting gear being run in an oil bath. In addition to the normal types, a speciality is shown which is known as the kettle-spout ladle, an arrangement which effectively keeps back the slag. On page 3 a service is indicated for the conversion of existing ladles to the Collin system.

Welding Cast Iron.—The Suffolk Iron Foundry (1920), Limited, Stowmarket, have published a second edition of their catalogue. It has been considerably enlarged and now includes a certain amount of data useful to the welder. It contains forty pages, and is well illustrated. We consider a slight mistake has been made in numbering certain of the line drawings as they are merely decorative and not utilitarian. We do not suggest their deletion, but merely the erasure of figure numbers.

Railways in Persia.—The Shah of Persia performed on October 16 the inaugural ceremony of the first railway station at Teheran in the presence of the Crown Prince, Ministers, members of the Persian Parliament, notables and members of the diplomatic corps.

40 Years' Experience in the Design and Construction of Fans

for

Heating and Ventilation of Buildings, Mines and Ships,
High Pressure Blast for Forges, Furnaces and Cupolas,
Mechanical Boiler Draught,
Fume and Steam Removal,
Dust Removal and Collection,
Cooling and Drying Plants.

means

Expert Knowledge, High Efficiency, Reliability and Good Service

Davidson's the SIROCCO TRADE MARK Fan Makers

have an experience covering hundreds of different industries and hundreds of different uses, and they can furnish a Sirocco Fan for every purpose for which a fan can be employed.

Solve your fan problems by using the Sirocco Service.

DAVIDSON & Co. LIMITED

SIROCCO ENGINEERING WORKS - BELFAST

LONDON - BIRMINGHAM - CARDIFF - BRISTOL MANCHESTER - GLASGOW - NEWCASTLE

PIG IRON and High Grade CYLINDER IRON

For Motor Castings.

FOUNDRY & FURNACE COKE

J. C. ABBOTT & Co LTD

LLOYD'S BANK CHAMBERS, NEW STREET, BIRMINGHAM.
TELEPHONE: MIDLAND 170.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	60 13 9
Three months	60 16 3
Electrolytic	66 10 0
Tough	64 0 0
Best selected	64 10 0
Sheets	90 0 0
India	75 10 0
Wire bars	66 5 0
Do. December	66 0 0
Do. January	66 0 0
Ingot bars	66 0 0
H.C. Wire rods	70 15 0
Off. av. cash, Nov.	59 17 3 3/11
Do. 3 mths., Nov.	58 18 0 11/16
Do., Sttlmnt., Nov.	58 17 3 3/11
Do., Electro, Nov.	63 19 6 2/11
Do., B.S., Nov.	63 8 7 1/3
Aver. spot price, copper, Nov.	58 17 3 1/2
Do., Wire bars, Nov.	64 3 10 1/2
Solid drawn tubes	12 1/2d.
Brazed tubes	12 1/2d.
Wire	9 1/2d.

BRASS.

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8 1/2d.

TIN.

	£ s. d.
Standard cash	271 0 0
Three months	265 7 6
English	269 0 0
Bars	270 5 0
Straits	274 15 0
Australian	274 15 0
Eastern	270 5 0
Banca	272 15 0
Off. av. cash, Nov.	262 13 9 1/2
Do., 3 mths., Nov.	258 11 9 3/4
Do., Sttlmt., Nov.	262 13 2 7/11
Aver. spot, Nov.	262 13 9 1/2

SPELTER.

	£ s. d.
Ordinary	26 11 3
Remelted	26 0 0
Hard	21 0 0
Electro 99.9	31 0 0
English	27 2 6
India	22 10 0
Zinc dust	35 0 0
Zinc ashes	9 0 0
Off. aver., Nov.	26 2 10 12/14
Aver., spot, Nov.	26 5 7 1/2

LEAD.

	£ s. d.
Soft foreign ppt.	22 2 6
English	23 10 0
Off. average, Nov.	21 2 0 22/44
Average spot, Nov.	20 17 9 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	35 0 0
Do. V.M. ex whf.	33 10 0
Rods	42 0 0
Boiler plates	30 10 0
Battery plates	32 0 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	64 10 0
Chinese	41 10 0
Crude	37 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	23 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 17 6
45/50%	£12 17 6
75%	£22 6 0
Ferro-vanadium—	
35/40%	14/3 lb. va.
Ferro-molybdenum—	
70/75% c. free	5/- lb.
Ferro-titanium—	
23/25% carbonless	11 1/2d
Ferro-phosphorus, 20/25%	£17 15 0
Ferro-tungsten—	
80/85%, c. fr.	1/3 lb.
Tungsten metal powder—	
98/99%	1/8 lb.
Ferro-chrome—	
2/4% car.	£33 0 0
4/6% car.	£23 2 6
6/8% car.	£22 17 6
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£35 15 0
Max. 1% car	£41 12 6
Max. 0.70% car	£53 0 0
70%, carbonless	1/4 lb.
Nickel—99%, cubes or pellets	£172 0 0
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£105 0 0
Metallic chromium—	
96/98%	2/11 lb.
Ferro-manganese (net)—	
76/80%, loose	£13 0 0
76/80%, packed	£14 0 0
76/80%, export	£12 0 0
Metallic manganese—	
94/96%, carbonless	1/10 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 6
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 1/16 in.	1/- lb.
Flats, 1/4 in. × 1/4 in. to under 1 in. × 1/8 in.	3d. lb.
Do., under 1/4 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d. to £ s. d.
South Wales—	
Hvy. steel	2 19 0 to 3 0 0
Bundled steel and shrngs.	2 12 6 to 2 14 0
Mixed iron and steel	2 12 0 to 2 13 6
Heavy cast iron	2 18 0 to 3 0 0
Good machinery for foundries	3 2 6
Cleveland—	
Heavy steel	2 17 6
Steel turnings	2 6 0
Cast iron borings	2 3 0
Heavy forge	3 12 6
Bushelled scrap	3 2 6
Cast-iron scrap	3 2 6 to 3 6 0
Lancashire—	
Cast-iron scrap	3 5 0
Hvy. wrought	3 2 6
Steel turnings	2 2 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	51 0 0
Brass (clean)	39 0 0
Lead (less usual draft)	20 0 0
Tea lead	17 0 0
Zinc	17 0 0
New aluminium cuttings	76 0 0
Braziery copper	47 0 0
Gunmetal	48 0 0
Hollow pewter	170 0 0
Shaped black pewter	130 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	67/6
Foundry No. 3	65/-
Foundry No. 4	64/-
Forge No. 4	63/6
Hematite No. 1	72/-
Hematite M/Nos.	71/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	85/-
,, d/d Birm.	89/6 to 91/-
Midlands—	
Staffs. common*	—
,, No. 4 forge	62/6
,, No. 3 fdry.	64/- to 65/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	54/-
,, fdry. No. 3	60/- to 61/-
Derbyshire forge	60/-
,, fdry. No. 3	65/- to 66/-
,, basic	—
Scotland—	
Foundry No. 1	—
,, No. 3	72/-
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	65/-
,, fdry. No. 3	68/-
Lincs. forge	66/-
,, fdry. No. 3	68/-
E.C. hematite	85/-
W.C. hematite	89/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	74/-
Northants foundry No. 3	—
Dalzell, No. 3	100/- to 102/6
Summerlee, No. 3	88/- to 94/-
Glengarnock, No. 3	88/- to 94/-
Gartsherrie, No. 3	88/- to 94/-
Monkland, No. 3	88/- to 94/-
Coltness, No. 3	88/- to 94/-
Shotts, No. 3	88/- to 94/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d. to £ s. d.
Iron—	
Bars (cr.) nom.	9 15 0 to 10 15 0
Angles	—
Tees to 3 united ins.	—
Nut and bolt iron	9 0 0
Hoops	12 10 0
Marked bars (Staffs.) f.o.t.	13 0 0
Gas strip	12 0 0
Bolts and nuts, 1/2 in. × 4 in.	15 5 0
Steel—	
Ship plates	8 2 6 to 8 7 6
Boiler plts.	10 10 0
Chequer plts.	10 5 0
Angles	7 12 6
Tees	8 12 6
Joists	7 12 6
Rounds and squares, 3 in. to 5 1/2 in.	7 15 0
Rounds under 3 in. to 1/2 in. (Untested)	8 0 0 and upwards
Flats, over 5 in. wide and up	9 2 6
Flats, 5 in. to 1 1/2 in.	8 2 6
Rails, heavy	8 2 6 to 8 7 6
Fishplates	12 10 0
Hoops (Staffs.)	10 10 0
Black sheets, 24g.	10 2 6
Galv. cor. shts., 24g.	13 7 6
Galv. fencing wire 8g. plain	12 10 0
Billets, soft	£5 15 0 to 6 10 0
Billets, hard	8 2 6
Sheet bars	£5 12 6 to 5 15 0
Tin bars	£5 12 6 to 5 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2 1/2
Sheet to 10 w.g.	1 3
Wire	1 3 1/2
Rods	1 3
Tubes	1 8 1/2
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3 1/2 to 1/9 1/2
To 15 in. wide	1/3 1/2 to 1/9 1/2
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4 1/2 to 1/10 1/2
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5 1/2
Ingots rolled to spoon size	1/- to 1/8 1/2
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	19.76
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	16.00
Basic	19.50
Bessemer	19.76
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	90.00
Bess rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.30
Sheets, black, No. 24	2.75
Sheets, galv., No. 24	3.65
Sheets, blue an'l'd., 9 and 10	2.10
Wire nails	2.50
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	—
,, furnace	13/6
Other Districts, foundry	—
,, ,, furnace (basis)	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	17/9
,,	28×20	,,	35/6
,,	20×10	,,	—
,,	18 3/4×14	,,	—
C.W.	20×14	,,	17/1 1/2
,,	28×20	,,	—
,,	20×10	,,	—
,,	18 3/4×14	,,	—
Terneplates	28×20	—	per box basis f.o.b.

SWEDISH IRON.

Bars, hammered, £18 10 0 to 19 0 0	
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to £6 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½% ..	45%
Water	63½%	40%
Steam	60%	35%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Dec.	1	..	59	11	3	inc.	2/6
,,	2	..	60	5	0	,,	13/9
,,	5	..	60	7	6	,,	2/6
,,	6	..	60	7	6	No change	
,,	7	..	60	13	9	inc.	6/3

Electrolytic Copper.

			£	s.	d.		
Dec.	1	..	65	0	0	No change	
,,	2	..	65	5	0	inc.	5/-
,,	5	..	65	15	0	,,	10/-
,,	6	..	65	15	0	No change	
,,	7	..	66	10	0	inc.	15/-

Standard Tin (cash).

			£	s.	d.		
Dec.	1	..	268	10	0	inc.	10/-
,,	2	..	267	17	6	dec.	12/6
,,	5	..	269	0	0	inc.	22/6
,,	6	..	269	15	0	,,	15/-
,,	7	..	271	0	0	,,	25/-

Tin (English ingots).

			£	s.	d.		
Dec.	1	..	267	0	0	inc.	10/-
,,	2	..	266	10	0	dec.	10/-
,,	5	..	267	10	0	inc.	20/-
,,	6	..	268	5	0	,,	15/-
,,	7	..	269	0	0	,,	15/-

Zinc Sheets (English).

			£	s.	d.		
Dec.	1	..	35	0	0	No change	
,,	2	..	35	0	0	,,	,,
,,	5	..	35	0	0	,,	,,
,,	6	..	35	0	0	,,	,,
,,	7	..	35	0	0	,,	,,

Spelter (ordinary).

			£	s.	d.		
Dec.	1	..	26	7	6	dec.	5/-
,,	2	..	26	10	0	inc.	2/6
,,	5	..	27	0	0	,,	10/-
,,	6	..	26	15	0	dec.	5/-
,,	7	..	26	11	3	,,	3/9

Lead (English).

			£	s.	d.		
Dec.	1	..	23	5	0	No change	
,,	2	..	24	0	0	inc.	15/-
,,	5	..	24	5	0	,,	5/-
,,	6	..	23	15	0	dec.	10/-
,,	7	..	23	10	0	,,	5/-

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	6 0 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 3 9
1898	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 5 0	6 5 0	6 10 0	6 10 0	6 2 11
1899	6 10 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 10 0	7 10 0	8 10 0	9 0 0	9 0 0	9 10 0	7 12 11
1900	10 0 0	10 10 0	10 10 0	10 10 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	9 10 0	8 15 0	8 15 0	10 1 3
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8½
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 8	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 3 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2½
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	—	—

* No quotations available owing to strike.

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